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Aeronautical Engineering

Edited by - - THURSTAN JAMES

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THE PRICE OF FOOD

ONE day last week we had to go to Edinburgh and of course went by air. Such is the high cruising speed attained by the Viscount 800 aircraft of our national domestic airline that we were able to complete most of our day's work before having to drive down to London Airport for the 90-minute journey. We left around 5.30 in the afternoon and sailed along smoothly in the sunshine at 18,000 ft. It was therefore with some surprise that we learned over the Lake District that conditions at Turnhouse were so poor that we should have to divert to Renfrew. This we did, arriving around 7.30 and, after a comparatively short stay at the airport, were marshalled into waiting coaches.

As we sped along the fine highway that spans Scotland between Glasgow and Edinburgh the weather progressively worsened until it was not hard to appreciate the tale of woe regaled next day by a motorcyclist from England who had been forced by fog to reduce speed to 20 m.p.h. as he came up from the border. Those in the coach had declared their destination as George Street, Edinburgh, yet both buses were diverted to Turnhouse where all the luggage was taken off, mixed up and reloaded. Consequently we did not arrive at our hotel until after 10 o'clock.

On our return, 48 hours later, to L.A.P. passengers were off-loaded from the aeroplane into a coach in which elderly and crippled persons had to strap-hang for a journey of a far fewer yards than we had to walk through the covered ways and moving staircases of our monstrously fine airport. In other words, it seems hard to believe that such uncomfortable land transport was really necessary.

It was certainly in marked contrast to the luxurious service we had on the trip to Scotland. True, we did have to endure the doubtful pleasures of tourist seating. Indeed it is no fun being the middle one in a three-seater row, but such thoughts were not likely to rankle much in view of the extremely competent and courteous cabin service. On this occasion, no doubt for training purposes, there was a cabin crew of four to serve tea and biscuits and drinks.

In marked contrast the bus journey to Edinburgh was infinitely more tedious in that passengers were now hours late. On this 90-minute trip there was one crew member on what we might call the flight deck and no cabin service. Thus driving along under the leaden overcast and with no attentions to divert one, the contrast between service in the air and on the ground became emphasized.

When one crosses the Atlantic the first thing that always strikes at least one passenger is the high proportion of crew to passengers. The same sort of contrast impressed itself following the trip by air to Edinburgh. Why, one speculated, does one have to be fed coffee and cakes and alcoholic beverages for an hour or so of comfortable travel in the sky? One spends much longer in other forms of transport without sustenance and often in conditions much more cramped than those such as the tourist seating of a modern airliner.

On both air trips we were travelling with a load of passengers that seemed very close to that purely theoretical figure of 100% load factor, but even 52 passengers are scarcely able to consume enough cigarettes and alcohol for the sales to offset the wages of a cabin crew of four whose average salaries are, we suppose, better than £10 per week each. They certainly deserve every penny of what they get. But our observations are not concerned with wage rates. What we are wondering is whether a necessity in the early days of air travel is not in danger of becoming a tradition. Must luxury service of food and drink be provided by our domestic airlines for short journeys? We cannot believe that either food or drink is a necessity for any journey of less than three hours' duration. We do, of course, assume that good food and drink are available both at the airport of departure and arrival.

Surely, the essential objective for all providers of airborne transport must be to pass on to the travelling public at the lowest price compatible with orthodox finances the savings of time which the genius of the aircraft engineer and designer makes available. These savings can get frittered away by poor airport design, by poor baggage handling and incompletely integrated transport arrangements. And the profits such saving of time could earn may be cut into by the cost of providing meals.

A further point is the effect that the reduction of meals served and the amount of refreshment carried have on turn-round times. A considerable organization is required, not only to provision aircraft but to reprovision them at turn-round. Moreover, all the empties and used crockery have to be removed.

We must not forget that there is a statutory requirement to have a member of the crew able to attend to passengers in case of sickness. And it is reasonable to use such persons as dispensers of cheer. Nevertheless, we doubt whether the lack of refreshment on flights of less than three hours' duration between airports with adequate restaurant facilities would reduce load factors. Indeed, such a decision could only raise the passenger capacity offered.

MATTERS OF MOMENT

Gatwick's Royal Inauguration

AT 10.15 hrs. next Monday, June 9, the new Gatwick Airport is due to be opened by Her Majesty The Queen.

She will fly with H.R.H. Prince Philip, Duke of Edinburgh, in a D.H. Heron of The Queen's Flight from London Airport to Gatwick. The flight will start from Bay No. 1, L.A.P. North at 09.30 hrs. and will end at Stand No. 16, Gatwick Airport, at 09.50 hrs.

A Notam (No. 387) explains the arrangements made to ensure the control of the movements of all traffic in the control area between 09.15 and 10.00 hrs.

Although intended only as a supplementary and diversionary airport for London, Gatwick has a special interest for all concerned with air transport. It is the first large airport in the U.K. to have been planned *de novo*. Next week's special Airport Equipment issue of THE AEROPLANE will feature an illustrated description of the new airport.

New Chairman for the R.Ae.C.

COLONEL C. F. H. GOUGH, M.C., T.D., M.P. (C.) for Horsham, has been elected chairman of the R.Ae.C. for 1958-59. He succeeds Mr. S. Kenneth Davies, C.B.E., who was appointed vice-chairman in 1948 and chairman in 1952.

Colonel C. F. H. Gough.

The new chairman has been a member of the R.Ae.C. since 1936, and was elected to the committee in 1953. He is an underwriting member of Lloyd's, and deputy chairman of Hobbs, Savill and Bradford.

When the first British Airborne Division was formed in 1941 Col. Gough was one of the eight original commanders. He commanded the first Airborne Reconnaissance Unit from that time until he was made a prisoner of war during the Arnhem operations.

He formed and commanded the 11th Middlesex Parachute Battalion, T.A.; was a co-founder of the Airborne Club and is a trustee of the Airborne Forces Security Fund.

NATIONAL CHAIRMAN RETIRES.—After 12½ years, Air Marshal Sir Robert Saundby (right) is retiring as Chairman of the National Council of the Royal Air Forces Association. Elected an Honorary Vice-president at the annual conference at Edinburgh last week, he received from the R.A.F.A. President, Marshal of the Royal Air Force Lord Tedder, a leather-bound volume containing the names of branches which by their donations have made it possible for Sir Robert and Lady Saundby to make a trip to South Africa.

Better than Ever

SO FAR this year the aircraft industry has boosted its export trade by more than a million pounds a week and is now earning, on average, about £3 million weekly overseas.

The record total for the first four months—£50,257,246—represents a gain of 53½% over the figure for the same period last year, an increase of £17½ million in 17 weeks. The January-April figure (which exceeds the annual totals of every year up to and including 1952, only falling short of the 1953-55 totals by a maximum of £16 million) represents £150 million for the full year.

The April total—£13,923,247—was the third highest monthly figure ever achieved. Aircraft and parts amounted to £9,671,599; aero-engines, £3,744,586; electrical appliances, £293,928; tyres, £59,893, and aeronautical instruments, £153,241. Canada was our best customer with £2,282,905, then India (£1,819,478), the Irish Republic (£815,634), West Germany (£637,737), Australia (£297,898) and the U.S. (£231,871).

LONDON'S NEW AIRPORT.—This aerial view shows the layout of the new Gatwick, which, as recorded above, will be opened by H.M. The Queen next Monday. An illustrated description of Gatwick will be a feature of next week's special issue of THE AEROPLANE in which airport design problems will be discussed.

Photograph copyright "The Aeroplane"

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BELFAST VTOL.—The Short SC.1. VTOL research aircraft has made its first vertical flight, tethered in the special gantry at Belfast. It was flown by Mr. T. Brooke-Smith, the company's chief test pilot.

The January-April aircraft and parts figure — £32,866,561 — exceeded total exports for the same period last year by about £100,000. Aero-engine sales amounted to £15,502,896 (against £11.7 million during January-April, 1957), electrical appliances, £1,099,775; tyres, £189,795, and aeronautical instruments, £598,219.

Dollar exports during this period were, at £7.4 million, greater than ever before. Canada (£5,608,091) and the United States (£1,756,609)—a total of more than $20 million—were second and third in the list of overseas buyers. India, with £6,852,324, headed the list, with West Germany (£1,592,013) fourth, Eire (£1,551,761) fifth, and Australia (£1,351,711) sixth.

R.A.F. Gliding Goes Ahead

IN all the gliding contests hitherto held in Britain—national, international and local, none of the best performances has approached that of this year's R.A.F. Gliding Championships at South Cerney, just outside Cirencester in Gloucestershire, from which Sergeant Andrew Gough flew 349 miles to the southern tip of Holland, beating the British National distance record of 318 miles and the U.K. Local record of 315 miles.

Gough started from South Cerney with an aero-tow to 2,000 ft. He made the 142 miles to Folkestone in 2 hr. 50 min. at 50 m.p.h. average, and there his ground crew had to stop and watch him setting out over the water from 6,000 ft. above it. But he was down to 2,000 ft. before sighting the French coast, and then saw, from the direction of the waves, that he had better change course and head for Dunkirk.

After the Channel crossing he turned inland, but lift was poor and only improved as he approached Ghent. Over Brussels he looked down on the Exhibition and thought of putting the Skylark on show there. Then he made for R.A.F. Geilenkirchen just across the German border, but at 3,000 ft. above Heerlen he spotted some gliders on a Dutch airfield, so went down to land.

On the way down he was rather surprised to find himself suddenly surrounded by all sorts of Dutch aircraft and descending parachutists. This was as late as 21.00 hrs. B.S.T.

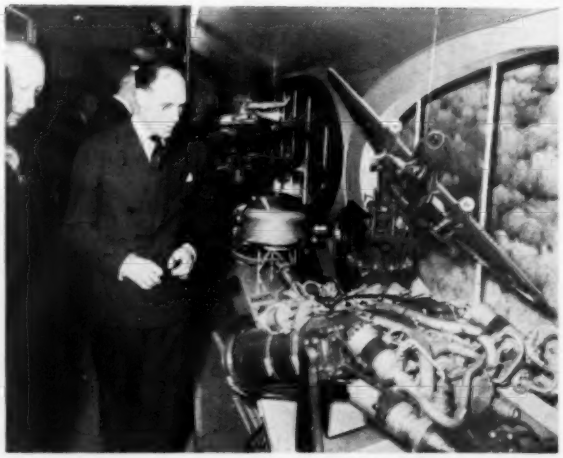
Six members and one glider formed the full strength of the R.A.F. Gliding and Soaring Association when it was founded in 1949. Its first championship meeting was held two years ago at Netheravon, and this was the second; future ones are likely to follow every two years, alternating with the British Nationals, which alternate with the World Championships.

This time there were over 150 people concerned, with about 40 pilots from eight different gliding clubs flying 20 sailplanes. Of the last, five had no struts to their wings and formed the high-performance class, and the rest were in the strutted-wing class. It is unlikely that so many struts will be seen again at an R.A.F. Championship, for the Association's allocation from the R.A.F. Sports Fund has been suddenly increased, possibly as a result of the Army and Navy being so well represented in the British international team. A whole lot of new machines has been ordered, including 15 Olympias, another Skylark 3, and another Eagle, together with more Sedberghs for training.

The R.A.F. Championships lasted 10 days, and although there were only four on which enough people scored to make a contest day, these four were really good.

Sgt. Gough won the Championships for Wessex, with Wg. Cdr. Kearon, also of Wessex, in second place and the Moonrakers' Gull third. In the strutted class Sqn. Ldr. E. T. Ware won for Fenland with the Gull I, and Wessex took second and third place. The day-by-day story of the Championships, reported by Dr. A. E. Slater is on page 791.

SANTA MONICA DEBUT.—The first Douglas DC-8 is seen here just after taking off on its initial flight from Long Beach, California. Some comments on the flight appear on p. 772.



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NAPIER IN LONDON.—The Rt. Hon. Aubrey Jones, Minister of Supply, opened the Napier exhibition on June 2 (see pp. 781 and 793). Here he is examining a Double Scorpion rocket engine. On the left is Sir George Nelson, Bt., Chairman of Napiers and of the parent company, the English Electric Co., Ltd.

A Hawker VTO Project?

A RECENT newspaper report spoke of a new lightweight vertical take-off fighter which has been designed by Hawker Aircraft, Ltd. It stated that U.S. financial support may be given and the fighter produced for the NATO air forces. A prototype, it was said, could be produced within two years; it would use a special version of the Bristol Orpheus turbojet.

No comment on this report is forthcoming from Hawkers or Bristol Aero-Engines, but they do not deny the existence of such a project. The aircraft might well be produced for NATO as its third-generation lightweight strike aircraft. The Fiat G91, with an Italian airframe and a Bristol Orpheus, has already been selected for NATO service until 1961 and the second-generation aircraft to succeed it is likely to be the Breguet Taon.

Choice of an Orpheus-based powerplant would seem logical for a deflected-thrust VTOL aircraft; the Orpheus 3 has a thrust-to-weight ratio of no less than 5.88 : 1. This could probably be increased greatly if a ducted-fan version of the engine were produced. Thrust deflection might then give a lightweight strike aircraft enough thrust for VTOL performance. If the thrust-deflection technique were used it would probably be lighter than the installation of a bank of special vertical-lift engines as on the Short SC.1.

Built-in VTOL capability enables designers to produce the most efficient wing for operational requirements. Wing area and loading are not dictated by take-off and loading requirements and flaps are unnecessary. The delta wing, with its combination of stiffness, lightness for a given thickness/chord ratio, and ample fuel capacity, would appear a logical choice.

U.S.A.F. Support for Friendship

THERE is every likelihood that a U.S.A.F. order for the Fairchild F-27 (Fokker Friendship) will be announced in the not too distant future, our representative reports after a recent visit to Hagerstown.

Fairchild are anxious to sell to the U.S.A.F. on an off-the-shelf basis, which would concern the cargo-convertible version with large forward freight door—and, of course, Dart engines. There is some reticence, we understand, on the part of the U.S.A.F. in accepting the Dart (on political grounds alone), but to substitute an unproven U.S. turboprop would be a retrograde step.

Several rôles are foreseen for the military F-27, including medical evacuation, aerial photography and charting, airfield radio and radar calibration, navigation training and transport.

Success in selling the F-27 to the U.S.A.F. would, once again, give military backing to a commercial transport. Now that the Electra has been ordered by the U.S. Navy, only the DC-8 and Convair 880 are left without such backing—and both use military engines.

The development programme suffered a slight set-back recently when the main undercarriage of the first F-27 folded on the ground and the fuselage was severely buckled. While this aircraft is being restored to flying trim the bigger Dart 528 (R.Da.7) engines are being installed; meanwhile the second F-27 picked up the flight-test programme on May 23 and the third aircraft will be handed over to West Coast Airlines on June 22.

G.A.P.A.N. Looks Forward

IMPORTANT matters were raised at the banquet given by the Worshipful Guild of Air Pilots and Air Navigators in London on May 28. The occasion was notable for the number of aviation personalities present.

The first point concerned the founding of a college of air pilotage, the next disclosed the intention of the Guild to find new offices, not in the historic City, and the third the question of direct subsidy for the development of British airliners through operation by Transport Command.

SIR WILLIAM HILDRED, director-general of I.A.T.A., described himself as an exile, a kind of international maid of all work, and took the opportunity, while proposing the health of the Guild, to work in a couple of delightful American stories, one of them explaining how one type of Middle-western farmer ensures domestic discipline. He urged on his audience the need to foster and fortify the Guild, for nothing must be allowed to interfere with the standard of air pilotage nor the supply of pilots to the most rapidly growing industry in the World.

SIR FREDERICK TYMMS, the Master of G.A.P.A.N., in expressing the regret of all present for the absence of their Grand Master, spoke of the Guild's good fortune in its long association with the Royal Family and recalled that the Duke of Kent had become Grand Master in 1936.

He disclosed that the present accommodation for the Guild in Londonderry House had become too confined and that new accommodation was being arranged in the West End.

Reminding his audience of the fact that a shortening supply of pilots must be expected from the Royal Air Force, he emphasized that it was incumbent upon the industry to meet this problem in time. He spoke of the need of a College of Flying, a University of the Air, which should parallel the College of Aeronautics at Cranfield and produce the men to man the air services of this country. It should also provide post-graduate courses which would train pilots, when their flying was done, to graduate from the flight deck to management.

LORD KNOLLYS suggested that in 1958 we had reached a very important stage in British aviation. How the situation was handled by Government and industry would affect the future of the country. One of the things not covered by the Government statement on air policy was the ever-increasing cost of development.

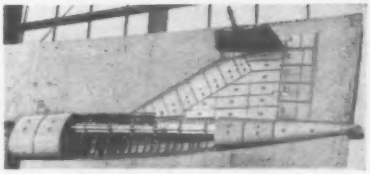
He argued that it should be met in the way that the aircraft industry was generously supported by U.S. Transport Command. "This enormous cost" could be met by using in part the independent companies and by R.A.F. Transport Command. Such sponsored development flying would be the most practical constructive and economic way if the industry were to survive.

Supersonic Research by Bristol?

A "STRAIGHT thin-wing research aircraft built in steel" was mentioned in evidence before the 1956 Select Committee on Estimates during its inquiry into the supply of military aircraft. Rumour has associated this supersonic research aircraft with Bristol Aircraft, Ltd., and we note with interest that Dr. A. E. Russell, chief engineer of the company, had some significant things to say recently which may have a bearing on its design. He was giving the Wallace Rupert Turnbull Lecture before the Canadian Aeronautical Institute; it was titled "Some Recent Aids to Aircraft Design."

Dr. Russell's paper indicated the thorough investigations into flutter and kinetic-heating phenomena which lie behind a supersonic research aircraft. On the flutter side, for example, flutter coefficients are calculated using a digital computer, and the effect of varying significant parameters is checked on an analogue computer. Theoretical results are checked experimentally using flexible models. These are tested in subsonic wind-tunnels and on free-flight and rocket-sled vehicles.

Two main types of flexible model are used, the "idealized" and the "representative." Idealized models consist of a small number of cantilevers which reproduce the calculated bending and torsional stiffnesses and elastic-axis positions of the aircraft. Lightweight boxes attached to the cantilevers give the correct



This idealized tail-unit flutter model may be related to Bristol supersonic research.

aerodynamic shape without contributing stiffness. Ballast boxes represent the aircraft's mass distribution.

Such idealized models are simple and their parameters can easily be changed. They are usually tested at low airspeeds and compressibility effects are ignored. Damage following a flutter incident is usually confined to the boxes. Main drawback of these models is that they rely on calculated stiffnesses and elastic-axis positions, and these calculations may not be very reliable for the fin-tailplane junction on a T-tail or for low aspect-ratio surfaces with discontinuities.

Representative models reproduce in a simplified form the actual structure of the full-scale aircraft. Such models are tested at full-scale speeds.

Representative models are tested in free flight with boost-glide or boost-sustainer-glide rocket vehicles. Boost should not go above 80% of design speed so that the sustainer can accelerate the vehicle gradually to maximum speed, and flutter has an opportunity to develop.

Theoretical analysis of kinetic-heating problems is very complicated, and critical conditions must be checked experimentally. The rapid heating needed to induce the correct transient thermal conditions demands a very large heat supply. It seems impossible to check the effects of rapid cooling other than by actual flight tests.

As yet it has not been necessary to include thermal effects of aerodynamic heating in major fatigue tests. Exploration of the effects combined with normal load factors for the smallest inhabited aircraft is so complex and expensive as to tax most private resources.

Hunting's New Jetliner Project

A PHOTOGRAPHIC impression which appears on this page of the new Hunting Aircraft jetliner project shows the H-107—to give it its domestic type number—as a good looking and thoroughly up-to-date turbine transport with two fuselage-side-mounted rear engines. What this illustration does not show so clearly is the concomitant swept wing (about 20° on the quarter-chord line) for high-speed performance.

In its broadest terms the aircraft is a short-range transport to carry up to 48 passengers at a cruising speed of 400 knots and has a still-air range of 1,350 nautical miles (which means, with allowances, a practical stage-length of around 700 n. miles). Power is provided by two Bristol Orpheus turbojet engines.

During a recent visit to Luton we were told something about the background of this most interesting project. It really began about two years ago when the design team there gave thought to a possible next step to follow the Pembroke/President series. Various types of aircraft were looked into—including piston-engined and turboprop types—and eventually it was decided to attack the problem of designing a small turbojet transport that would be attractive on short-haul routes when the bigger long- and medium-range jets would be in operation.

Studies that were made of likely stages all over the World confirmed that there were many on which the higher operational frequencies offered by a small pure-jet transport would show to economic advantage. The aircraft seemed to fill a promising potential market and could take over the routes now flown by slower comparable piston-engined and turboprop types, of similar size, and enable the same number of passengers to be moved much more swiftly and with fewer aircraft.

It might be added here that the H-107 is in no way suggested as a DC-3 replacement. But it can be considered as a suitable proposition for the next generation of transport aircraft to follow the out-dated piston-engined fleets. Its first-cost which will be in the £250,000 bracket, should prove most attractive to operators.

To begin with, the Hunting studies were based on a 32-seater weighing 33,000 lb. and capable of short-field operation in high-temperature/altitude conditions. Further studies suggested that 40 seats would be a better offering; that a stage-length of 400-500 miles represented a good average requirement; and that the high-temperature/altitude short-field operation could be relaxed slightly. This was achieved with a 39,000-lb. aeroplane.

Subsequent on-the-spot discussions with operators in a representative selection of countries throughout the World modified the basic specification a little to provide a 700-800 mile stage-length and a 5,000-ft. balanced field length. For this, the all-up weight was increased to 41,500 lb.—which gives a moderate wing loading of 52 lb./sq. ft. This was made possible by increases in the basic thrust of the engines and amendments to the airworthiness requirements.

With the sort of thrust bracket into which such an aeroplane comes, the choice of a twin-engined layout follows almost automatically and the Orpheus is an obvious selection.

After considerable investigation the Hunting Aircraft team were convinced of the advantages to be gained from a rear fuselage-mounted powerplant arrangement. With this, too, a twin-engined layout has much to commend it, particularly as regards the facility to provide random passenger loading—a condition very difficult to achieve with comparable three- or four-engined layout.

The powerplants are located right aft so that their rotating assemblies are behind the rear fuselage pressure bulkhead. This also keeps the pressure cabin outside the noise cone and jet efflux region—which is advantageous in keeping a low cabin noise level and also in eliminating the sonic fatigue problem. Another point in favour of having the engines really far back is that they can be kept as close together as possible and thus give better asymmetric-power characteristics. The high position of the engines should reduce the likelihood of foreign body ingestion.

Particular attention has been paid in the layout of the fuselage to give the maximum panoramic view to the crew and the windscreen has been designed to meet as near as possible the latest, stringent, American requirements regarding cockpit visibility. The cabin pressure differential will be 8¼ p.s.i.

At present this new Hunting project has only reached the final design-study stages but initial wind-tunnel tests have been completed and confirm most satisfactorily the aerodynamic estimates. A mock-up is in an advanced stage and a point has now been reached where detail design work is the next step. However, what is most needed now is some financial contribution towards the cost of the final design and development of a prototype—which for an aeroplane of this size is beyond the capacity of any one individual company such as Hunting Aircraft. But so far, Mr. W. A. Summers, C.B.E., F.R.Ae.S., their managing director, tells us, they have treated this as a comprehensive design study and have not yet approached anyone with a firm proposition. The H-107 remains, therefore, simply as a most promising project with an ambitious eye on a gap in the next generation of turbo-jet-engined air transport that badly needs to be filled.—F.T.M.

News of Aircraft, Engines and Missiles

SKI-P.9—L. Marmol, who operates an Edgar Percival EP.9 in his agricultural company, ADS (Aerial) Ltd., recently flew one of this type to north of Ostersund, for trials with Swedish military-type skis.

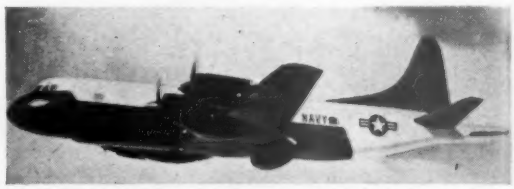
ALITALIA'S CONWAYS.—Following the announcement that Rolls-Royce Conway turbojets are to be fitted to the Douglas DC-8s on order for Alitalia, the Conway-powered Avro Vulcan was recently demonstrated to officials of the airline and other high-ranking people at Rome airport.

CLIMBING SKYRAY.—The U.S. Navy has announced that a Douglas F4D Skyray has established new rate-of-climb records. They are: 3,000 m. in 44.39 sec.; 6,000 m. in 1 min. 6.13 sec.; 9,000 m. in 1 min. 29.81 sec., and 12,000 m. in 1 min. 51.23 sec. The figures are substantially greater than existing official records, and the Skyray also reached 15,000 m. in 2 min. 36.05 sec., for which height no record exists.

RUSSIAN MISSILES.—Recent news from Germany gives details of five Russian missiles—the T-3 ICBM with a range of 3,000-5,000 miles; the T-4 IRBM with a range of 1,000 miles; the J-2 short-range 625-mile missile; the Comet II with a similar range to that of the J-2; and the Golem I 400-mile-range missile intended to be fired from submarines.

NAVAL ETENDARD.—The Atar-powered Dassault Etendard IVM Naval fighter made its first flight at Melun-Villaroche on May 21. It is intended that this type will be carried on the new French aircraft carriers "Clemenceau" and "Foch," now being built.

NAVAL ELECTRA.—Configuration of the anti-submarine version of the Lockheed Electra, which is to fly before the end of the year. The bulge under the fuselage accommodates radar and the plastic cone-shaped tail extension houses a MAD unit.



HIGH SKYLARK.—An altitude of 94 miles was attained at Woomera last month by a Skylark rocket. It was fired as part of the I.G.Y. programme and was used to measure air glow.

ALLISON MISSILES. — Reorganization of the aircraft engineering department of the Allison Division of General Motors has resulted in an expanded research department and a new missiles systems department.

NAVAL NEWCOMER. — The U.S.N.'s McDonnell F4H-1 two-seat fighter made its first flight on May 27. Span and length are 38 ft. and 56 ft. respectively.

NEW RUSSIAN. — According to reports from Soviet sources a new version of the Tupolev Tu-114, the Tu-114D, has completed a number of successful test flights. It has flown non-stop from Moscow to Irkutsk and back, a round-trip of 5,256 miles (G.C.), and also from Moscow to Vladivostok.

Mi-1 FLOATPLANE. — The latest variant of the Russian Mi-1 helicopter is a sea-patrol and whale-spotting version fitted with four cylindrical collapsible floats. They are mounted extra to the landing gear, which is longer than on the standard aircraft. Tests were recently made by test pilot M. Leshyn, who proved the aircraft capable of alighting on and taking off from considerably rough seas.

BIG MONEY.—During the first quarter of this year, the net income of the United Aircraft Corp. in America was $11,543,934 (about £4.1m.) compared with $10,967,663 for the same period last year. The Curtiss-Wright Corp. reports a consolidated net profit of $5,014,560 (about £1.8m.), on sales of $105,076,814 compared with $9,942,256 (about £3.5m.) on sales of $147,427,760 last year.

SOLID FUEL.—There have been reports from Canada of a new solid propellent for guided missiles. This is attributed to British, Commonwealth and American scientists; no details are given but it is likely that this springs from work done at R.A.E. Westcott where much development of missile solid propellents has been done in recent years.

ENGINE ORDER.—General Electric has a U.S.A.F. contract worth $300 million for the new J93 turbojet.

Commercial Aviation Affairs

B.E.A. FROM GATWICK.—After the Queen has opened Gatwick next Monday, June 9, B.E.A. will make an inaugural flight out of the airport with a DC-3 which will carry representatives of the Surrey County Council and other distinguished passengers to Jersey and Guernsey. As from this date B.E.A. will be operating most of their Channel Island services from Gatwick.

EASTERN ELECTRA.—The first of 40 Lockheed Electras on order by Eastern Air Lines made its first flight at Burbank on May 19. This aircraft, the fourth Electra to fly, is fully furnished and accordingly is much quieter than the three previous aircraft, which carried instruments for certification tests.

AUSTRALASIAN ELECTRAS. — Lockheed announces that orders for the Electra turboprop airliner now total 151, from 14 airlines and backlog amounts to £116 million. The latest orders are from Qantas (four), TEAL (three) and T.A.A. (two). The Australian Cabinet has also allowed Ansett Australian National Airways to purchase Electras, two of which will start that company's "Electraflight" service. Approval for these purchases was referred to in our issue of last week (p. 740).

B.K.S. INAUGURAL.—On June 4 B.K.S. Air Transport were due to make an inaugural flight with an Airspeed Elizabethan on the Newcastle-Bergen run.

MORE VISCOUNTS.—Three more Series 800 Viscounts have been ordered by Aer Lingus. These Mk. 808s will be delivered at the end of 1958 and early in 1959—increasing this operator's Viscount fleet to six 800s and three 700s.

INTO GATWICK.—Transair, Ltd.'s 12 "Dakmasters" and three Viscounts began moving in to Gatwick Airport between May 30 and June 3. This company is the first commercial user of the new airport.

SABENA TO MOSCOW.—On June 2 Sabena was to inaugurate a new direct service between Brussels and Moscow, with immediate connections by Sabena to and from the U.K. The London-Moscow service, via Brussels, is to operate once weekly until July 31, thereafter twice weekly. Aeroflot will operate a regular Moscow-Brussels-Moscow service, and some supplementary flights during the summer. These new services will provide direct connections from Moscow for Peking and other places in the Far East.

VISCOUNT 810s FOR HUNTING.—The announcement was made last week of an order for three Vickers Viscount Series 810 (type 833) from the Hunting-Clan Group. They will normally be operated as 64-seaters and will be powered initially with Dart 525s. These engines will be replaced in 1960 by the more powerful 541s. An order for four 832s from Ansett/A.N.A. was announced in last week's issue (p. 740). Viscount sales now total 387.

INTERLINE AGREEMENT. — On April 21 the West German airline, Lufthansa, and the Hungarian airline, MALEV, signed an interline agreement which came into effect on May 20.

AMERICAN AIRLINES' FLEET.—In his annual report to the stockholders Mr. C. R. Smith, president of American Airlines, said that medium-range turbojet aircraft would be ordered during 1958 in addition to the Boeing 707s and Lockheed Electras already on order. The first 707 services by American will be started late in 1958 between New York and the West Coast.

HERALD INTEREST.—Linea Aeropostal Venezolana (L.A.V.) is assessing the Handley Page Dart Herald as a possible DC-3 replacement. Recently two of the airline's officials, Mr. T. Knust and Capt. C. Lomera, were flown in it to Rolls-Royce at Hucknall.

GHANA'S AIRLINE.—Plans have been almost completed by the Government of Ghana and B.O.A.C. for the establishment of a Ghana airline. Representatives of B.O.A.C. were due to arrive in Accra on May 28, and the final agreement should be signed in time to allow services to begin in July. Ghana Airways will initially operate one Accra-London Stratocruiser service to B.O.A.C.'s three; eventually the two companies will operate an equal number of services.

Military Aviation Affairs

GOSPORT MEMORIAL. — Air Chief Marshal Sir Arthur Longmore unveiled this memorial at Gosport, Hants, on May 28. It commemorates the airfield's long association with the development of Service aviation including the beginnings of British naval flying.

DECK LANDING TOTAL.—During night-flying exercises from H.M.S. "Ark Royal" last month a Sea Venom of No. 893 Sqn. made the 10,000th deck landing of the carrier's second commission. Crew of the all-weather fighter was Lieut. J. Herringshaw, pilot, and Lieut. H. McLennan, observer.

FIGHTER DELIVERY.—The first Republic F-105 Thunderchief was delivered to the U.S.A.F. on May 27. Armed with the Vulcan 6,000 rounds/min. 20-mm. automatic cannon, the F-105 has Mach-2.0 performance and can carry nuclear weapons.

R-THETA NAVIGATION. — The R-Theta navigation computer system developed by Canadian Applied Research, Ltd., of Toronto, is to be installed in the 53 CF-100s being supplied to the Belgian Air Force under joint Canada-U.S. mutual aid. At the present time the French Air Ministry and the R. Swedish Air Board are evaluating the system.

REMEMBERING OUR ALLIES. — Polish Airmen's Week is being held from June 2 to 9. From the chairman of appeal, Air Chief Marshal Sir Hugh Pughe Lloyd, G.B.E., K.C.B., M.C., D.F.C., we understood that the financial resources at the disposal of the Polish Air Force Association in Great Britain are not great and are strained to the utmost. Donations should be sent to him at 14 Collingham Gardens, S.W.5.

GEORGE MEDAL.—Sgt. L. G. Birnie, of the Coastal Command Maritime Operational Training Unit, R.A.F. Kinloss, has been awarded the George Medal for rescuing an injured member of a Shackleton crew following its crash on a night-flying exercise. A signaller, Sgt. Birnie has recently been posted to No. 269 Sqn., R.A.F. Ballykelly.

VOODOOS FOR BRITAIN. — The McDonnell F-101 Voodoo is to replace the Republic F-84F Thunderstreak in the 81st Fighter Bomber Wing at R.A.F. Bentwaters, Suffolk, in the autumn, as part of the Third U.S.A.F. contribution to NATO air-strike forces.

BELGIAN DC-6s.—The first DC-6 transport for the Belgian Air Force has left the Douglas Santa Monica plant. This is the first sale of this type of transport, which is similar to the U.S.A.F. DC-6A, to a military service outside the U.S.

News About People

A.W. TO S.A.—Mr. C. S. Emery, sales director of Sir W. G. Armstrong Whitworth Aircraft, Ltd., is leading a sales team on a tour of South America to investigate the market for the A.W.650 Freightercoach and its variants. He is accompanied by Mr. D. L. Raffle, chief performance engineer, and Mr. Michael Spanyol, assistant to the civil aircraft designer in the company's London office. They left Britain on June 1.

TILTMAN LANGLEY TEAM.—In THE AEROPLANE for May 9 in recording the building up of a team of consultants by Tiltman Langley, Ltd., we reported that Capt. P. V. Hoare, of Westland Aircraft, had actually joined the company. Like other members of the team, he is in fact acting as an "outside" consultant.

AN AEROBATIC LOSS.—With the recent death, in Madrid, of Prince Constantin Cantacuzene, after a brief illness, aviation lost perhaps its leading aerobatic pilot. Prince Cantacuzene, who was chief pilot of the Rumanian National Airline until the post-War Communist *coup*, turned his flying skill in exile to perfecting a remarkable aerobatic display in a specially modified Bücker Jungmeister, which he brought to the U.K. on several occasions in recent years to take part in some of the bigger air meetings. During the War he became a top-scoring fighter pilot, with about 60 victories against Russian and Allied aircraft, but he played a leading part in negotiating the surrender of Rumania after being ferried to Italy in the radio compartment of a Mustang.

SEEING FOR THEMSELVES.—Dr. H. Ch. Seebohm, West German Minister of Transport, Ministerial Direktor Kallus, and Herr Hoeltje, executive of Lufthansa, arrived in London on June 2. They are to visit the Vickers-Armstrongs and Rolls-Royce companies.

ASSEMBLY PRESIDENT. — H.E. Toru Hagiwara, Japanese ambassador to Canada, has been elected president of the 11th session of the ICAO Assembly currently meeting in Montreal. He also serves as chairman of the Assembly's executive committee.

A FIELD APPOINTMENT. — Mr. H. St. G. Bond has been appointed European representative for Field Aircraft Services, Ltd., of London. He will have his headquarters in Geneva.

McCURDY TROPHY.—Mr. James C. Floyd, vice-president, engineering, of Avro Aircraft, Ltd., has been awarded the J. A. D. McCurdy Trophy for his work on the CF-105 Arrow all-weather interceptor. The trophy is awarded for the top achievement in the past year in Canadian aviation.

SHOREHAM ARRIVALS.—The R.Ae.C.'s international air rally was held from May 29 to June 1. On the right are some of the guests at Shoreham Airport. Top left, Mr. Strange-Hansen (KZ.III, Denmark), and Mr. S. G. Nicholson; top right, Mr. Oberman (Sokol, Holland) with Mr. Frank Buckell on left; lower left, Mr. Smits (Gemini, Belgium); and lower right, Mr. Meille (Falco, Italy).

AIR TRANSPORT

The DC-8 Flies

AT 10.10 hours local time on May 30 the second of the United States' major long-haul turbojet types—the Douglas DC-8—took-off on its first flight from Long Beach, California. After being airborne for 2 hr. 10 min., the prototype landed at Edwards Air Force Base.

A member of THE AEROPLANE'S staff, Mr. F. G. Swanborough, was visiting the Douglas plant at the time of the flight. He cabled us to say that the take-off was watched by about 50,000 Douglas workers and local populace. With a three-pilot test team aboard, led by A. G. Heimerdinger, the DC-8 left the ground at a weight of 197,000 lb. for which the calculated unstick speed was 130 knots. The take-off was smooth and was completed after a run of about 3,200 ft., but the JT3 engines, using J.P.4 fuel with water injection, produced clouds of black smoke which would certainly not be acceptable for civil airports. After leaving the ground the DC-8 climbed to 5,000 ft. before turning northwards along the coast and over the Pacific.

During the two-hour flight the landing gear and flap operations were checked, the general handling characteristics, both in normal flight and at the stall, were explored and the systems and emergency procedures were tested.

So far, 138 DC-8s have been ordered by 17 of the World's long-haul operators. The first nine aircraft from the assembly lines will be used for certification tests.

A picture of the DC-8, airborne on its first flight, appears on p. 768.

Elands and Tynes for Canadair

IN Montreal last month, Canadair had received 60 truck loads of Convair 440 jigs from San Diego. These jigs are being set up immediately so that a start can be made on producing the Canadair 540, with Eland engines, which has been ordered by the R.C.A.F. The first aircraft is expected to be rolled out next March and flown in May.

Canadair have taken the Eland powerplant installation as designed by Napier for the 340 and 440 conversion and are doing very little re-engineering for the production job. Complete powerplants will be supplied by Napier, and the remainder of the airframe will be standard Convair.

The first 10 aircraft supplied to the R.C.A.F. will consist of five personnel transports and five with rather more luxurious fittings for staff duties. These are both covered by the designation CL-66A, while the CL-66B is a freight version with a large cargo door in the fuselage—as used on some military Convair 340s. The R.C.A.F. designation is CC-109.

In order to provide preliminary experience, the Eland-Convair 340, at present being used for C.A.A. certification trials at Santa Monica, may be leased by the R.C.A.F. later this year. Meanwhile, Canadair have themselves purchased two Convair 440s which are now at Montreal and are to be fitted with Elands. They will fly in September and October and will be used to build up engine hours, and for demonstrations.

While the Canadair 540 is thus being brought rapidly into production, the company has been expending considerable efforts on the CL-44, ordered by the R.C.A.F. as the CC-106. The CL-44 basically, of course, is a lengthened Britannia with new powerplants. At various stages in the design considerable variety of engines had been considered—including the R-3350 (used in the CL-28 Argus), the Tyne Stage 1, the Bristol Orion, the Proteus and the Pratt & Whitney T34.

Since support was withdrawn for the Orion, the Tyne R.Ty.11 (Stage 2) has been finally chosen and the work of re-design, which included moving the wing back some two feet to preserve the c.g. position, is now nearly complete. Canadair now expect that the first CL-44D (as the Tyne variant is known) will fly at the end of 1959.

Both the Canadair 540 and the CL-44D are being actively pushed as commercial aircraft.

EXPENSIVE OUTING.—This remarkable picture is one of a series in which two 707s flew in formation for the benefit of Boeing photographers. They are the first and third (nearest the camera) production aircraft.

Clearing the Air

THE week during which a Capital Airlines' Viscount and a U.S.A.F. T-33 were in collision near Brunswick was one in which the whole subject of collisions and the control of air space was receiving the closest possible attention. It just so happened that a few days before the accident (as we recorded in last week's issue), the C.A.A. had made public its latest Federal Airways Plan—for 1959-63.

On May 17 the C.A.B. had issued a booklet entitled "The Advance in Air Safety," which was followed on May 19 by a listing of the 159 mid-air collisions involving U.S. civil aircraft which have killed 402 persons in 10 years. On May 20 the Viscount/T-33 collision occurred, and on May 21 and 22 a Bill was introduced in the House of Representatives and the Senate which seeks to create a Federal Aviation Agency with complete control over U.S. airspace.

In New York, when the collision was reported—and a day or two later in Washington—we were well able to judge the impact of this tragic affair on the general public. The sombre four-inch "Jet Rams Airliner" headlines in the popular Press played their part in stirring the public, but the accident itself, coming *less than a month* after that between a DC-7C and F-100 in California, was sufficient to set the Senators and Congressmen to work. Reactions ranged from the slightly hysterical to the faintly fatalistic, but the principal mood of both House and Senate was one of "let's get something done."

No one, however, was too sure what could be done with immediate benefit—as was shown on May 22 when President Eisenhower asked the Air Co-ordinating Committee, under chairman Lt. Gen. Elwood Quesada, to make a special study of means of eliminating collisions "to the maximum degree possible." Later the President approved five emergency measures which gave the C.A.A. control over military jet aircraft operating in the airways.

Collision Statistics

A study of the C.A.B. statistics on collisions between 1948 and 1957 shows that only three of these involved colliding airliners of which only one—the Grand Canyon disaster—resulted in airline passenger fatalities. Three more (not counting the two this year) involved airliners and military aircraft and another 12 were between airliners and light aircraft. There were 119 collisions in which each aircraft involved was in the general aviation category. A study of locations of the accidents shows that 26% were at airports, with a steadily diminishing percentage as distance from airports increased. About half of all the collisions occurred when one of the aircraft concerned was in the landing phase.

The C.A.A. have for long realized the very real danger of a crop of serious mid-air collisions occurring—such as has recently been the case. Their concern, and to some extent also that of the Senate and House, is shown in the latest revision of the Federal Airway Plan which was first published in 1956 to cover the Fiscal Years 1957-61. Enough money was appropriated in F.Y. 1957 to accomplish the first-year part of the five-year plan and part of the second year. The first revision of the plan sought to telescope five years' work into three and funds were appropriated in F.Y. 1958 on that basis.

The latest version of the plan—again modified in the light of the latest forecasts—shows that $1,027 million are needed in the next five years. All these plans, however, are based primarily on the expanded use of present types of equipment and it is rapidly becoming clear that a totally new concept of control is called for. The new equipment planned for operation in 1963 would probably be admirable for traffic as it is today; the difficulty lies in getting A.T.C. procedures ahead of traffic instead of one step behind.

Briefly, the Federal Airway Plan, 1959-63*, provides for 60 new long-range radars (including some military); 76 new airport surveillance radars; 30 new airport surface detection radars; 23 precision approach radars; 289 air traffic control radar beacon systems; 43 new VOR units; 573 new VORTAC installations and 337 TACAN units to convert VOR to VORTAC; 40 new ILS systems and equipment to modernize 225 others; and 69 new towers.

* Obtainable from the U.S. Government Printing Office, Washington 25, D.C., price 60 cents.

Possibly the most interesting part of the Plan is that concerned with the electronic processing of flight data. C.A.A. began investigating the use of electronic computers in October, 1956, with an IBM 650 at Indianapolis A.R.T.C. centre, and have found that individual flight progress strips can be prepared in one-thirteenth of the time taken by a manual controller and are more accurate and legible. The size of the "memory" of this computer is now being increased and new computers are being installed at New York and Washington to make a small three-centre complex working on a trial basis. Late in Fiscal Year 1959 it is planned to equip five centres in the north-east U.S. for automatic flight-data processing and additions will be made at the rate of six computers a year.

In this sphere of electronic computing of flight plans and processing of flight data, the C.A.A. is working closely with the Airways Modernization Board, which was set up in 1957 by Congress to plan and develop new devices and methods of A.T.C. beyond the period covered by the Federal Airway Plan.

The more important question remains, however—where, eventually, is the overall authority for control of airspace to be vested? While the development of equipment is a pressing need, it is one which has definable limits and requirements; the question of authority hinges on personal considerations involving both civil and military interests in the Government, Senate and Congress, and is therefore less easy to define.

The Federal Aviation Agency

The Bill, which, if passed into law, would be known as the "Federal Aviation Act of 1958," and was presented in the House of Representatives by Congressman Owen Harris and in the Senate by Senator A. S. Monroney, would vest this authority in the Federal Aviation Agency. As we understand it, this Agency would combine the functions of the C.A.B. and the C.A.A.; and its administrator, appointed by the President, would be required to consider, among other things:

(a) The regulation of air commerce in such manner as to best promote its development and safety.

(b) The promotion, encouragement and development of civil aeronautics.

(c) The control of the use of airspace of the U.S and the regulation of both civil and military operations in such airspace in the interest of the safety and efficiency of both.

(d) The consolidation of research and development with respect to air navigation facilities, as well as the installation and operation thereof; and

(e) The development and operation of a common system of air traffic control and navigation for both military and civil aircraft.

Item (c) is likely to meet stiff opposition from military spokesmen in the House and Senate, while item (e) would be no less fraught with difficulty under the F.A.A. than it is under the C.A.B., which has basically the same charge. Also likely to be a controversial item in the Bill is the suggested appointment of "a special military adviser" for the administrator, to keep him acquainted with the needs and special problems of the military services. Such an adviser would not, presumably, have the powers that the military authorities have to-day to use C.A.A. controlled airspace without giving any reasons.

With the Senate and Congress in their present mood it is not altogether impossible that the Bill creating the F.A.A. should pass into law during the present sitting, although such speed would be unnatural. This would still do no more than create the agency in name. The objects of the Bill can be achieved only when there is genuine co-operation and understanding between civil and military users of airspace—plus adequate equipment to control effectively the increasing numbers of aircraft in use. Any measures which fall short of this can only be palliatives and, it seems, can only reduce the risks of mid-air collisions by reducing the number of movements at the airports.—F.G.S.

[The military Services have since volunteered to reduce the number of turbojet flights below 20,000 ft. and to take-off and land under IFR when flying near airways. Meanwhile, too, government plans have been announced for the establishment this year of five coast-to-coast airways (at 17,000-22,000 ft.) in which all aircraft would fly to IFR. This is a first step towards the application of full control.—ED.]

New Equipment for N.Y.A.

NEW YORK AIRWAYS, one of the three U.S. scheduled domestic helicopter operators, introduced their new Vertol 44Bs into service on May 28 (as noted and illustrated in last week's issue, p. 740).

The Vertol 44B is the first twin-rotor helicopter to be used on scheduled services and, although it still suffers the inherent disadvantages of single-engined aircraft—plus, perhaps, some added mechanical complexity—it permits arrangement of the seats in an airline-type layout. When we visited N.Y.A. at La Guardia a week before the Vertols went into service, we found the company full of enthusiasm for their new equipment and hard at work building up crew experience, making practice approaches and fitting in publicity and photographic sorties.

The decision to purchase Vertol 44Bs (commercial models of the H-21 Work Horse) was made only a few months ago, and was a radical one in the sense that this was to be complete re-equipment from top to bottom—five Vertols would replace three S-55s and three S-58s. In fact, in terms of available passenger-seat-miles, they increase the airline's capacity by 51% per year.

N.Y.A. list several advantages which they will gain from using Vertols. Apart from the roomier, 15-seat cabin with carry-on luggage provision, there is the fact that this helicopter has built-in amphibious gear with little drag or weight penalty, and is less susceptible to c.g. variations than the S-58. Although the 12-passenger S-58 proved admirable in itself there were loading difficulties when flotation gear was fitted, and many services into the W. 30th Street heliport, in downtown Manhattan, had to be dropped. This difficulty is reflected also in the results for 1957, which show a 59% increase in passengers carried, a 48% increase in revenue ton-miles performed and a drop in revenue load factor from 52.21% to 39.81%.

Another thing which helped to persuade N.Y.A. to buy Vertols was the favourable terms offered by the makers. Vertol agreed to accept, under a trade-in agreement, the fleet of Sikorskys and spares, at their net book value of $1.1-1.2 million. This was arranged through William C. Wold Associates, who are disposing of the Sikorskys. N.Y.A. were required to find another $1 million or so for the Vertol fleet; this has been done through a loan from the Hanover Bank, the Federation Bank and Trust Co. and the U.S. Trust Co. of New York, with a U.S. Government guarantee under the terms of the Aircraft Purchase Loan Guaranty. (This is, we believe, the first government guarantee under the statute, enacted late last year, to help local service airlines and helicopter operators to finance new equipment by guaranteeing 90% of the total cost.)

C.A.B. approval for the new equipment and revised schedules, which will include an hourly service to the Manhattan heliport, was not actually obtained until May 15, two or three days after the first Vertol had been delivered to La Guardia. Two more followed before May 28 and all five will be in service in June.

Coincident with obtaining this new equipment, N.Y.A. have entered into a two-year agreement with the Airways Modernization Board to make operational trials with the Bendix-Decca Navigation System; the experimental New York chain should be operating by the end of June. The Vertols have been fitted with Decca Flight Logs and the customary Decometers. They also have the new Bendix sonic altimeter, which provides a very high degree of accuracy up to 300 ft. These two devices together should simplify very considerably the task of flying in marginal weather.

The method of operating the Vertols follows the usual pattern for helicopters, with a vertical take-off to 10 ft. or so, and then a forward run to build up speed before the climb-away. The Vertols cruise a little faster than the Sikorskys, but speed is of no very great consequence in the type of operation performed by N.Y.A. Much more important is the ability to operate on schedule in poor weather, and without c.g. restriction on passenger loading.

Integral steps have been provided, and carry-on luggage facilities. There are six double seats in the cabin down one side and three singles "filling up the corners." In the rear half of the cabin, the noise level is lower than that in a DC-6B, and there is an efficient air circulation system, with regular air vents and reading lights at each seat row.—F.G.S.

ROME'S NEW AIRPORT.—This picture, looking towards the east, shows the completed N-S runway lying left to right and the development of the terminal area for Rome's new airport on the coast near Fiumicino to the south-west of the capital.

Photograph copyright "The Aeroplane"

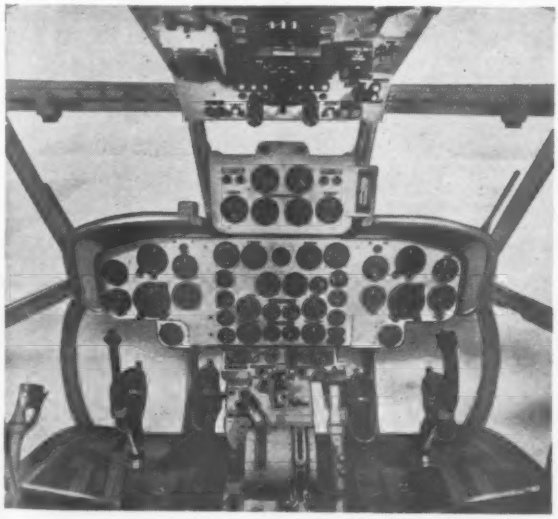
Rotodyne Progress Report

Earlier this week, the Fairey Rotodyne—Britain's first VTOL transport aircraft—was scheduled for demonstration in public for the first time. Here, we present an account, by MR. D. M. DAVIES, M.A., A.F.R.Ae.S., *the company's senior project engineer (helicopters), of the test programme so far accomplished.*

THE ROTODYNE is now well advanced, with its development programme having made upwards of 80 flights. It has completed on several occasions the transition from helicopter to completely auto-rotative flight and in both configurations it has flown at speeds of the order of 140 knots. The flight envelope is being extended steadily on a planned basis; each stage is cleared from the structural and handling viewpoints before progressing further. This conservative approach which permeated all preflight testing as well as actual flight tests has given excellent results so far. Although the Rotodyne embodies several novel features, progress has been smooth and is now proceeding at an accelerating pace.

From the outset the cyclic- and collective-pitch controls were found to be crisp and precise. (Fairey power controls are used with duplicate sources of hydraulic power.) Even on the very first flights the pilot was able to make extremely accurate landings. Directional control, provided at low speed by the propellers, is fully adequate. The only difficulties encountered with directional control in fact were some initial problems in rigging propeller pitch for identity on port and starboard engines when in the "manual" or "helicopter" regime.

The rotor controls, comprising hydraulic jacks, torque tubes and the swashplate mechanism, were tested on a rig at the Hayes factory. The rig was used to clear these items for an initial safe life and is now continuing with an endurance test. This is in addition to the Boscombe Down rig where all major components were tested full scale.



The heart of the rotor system is, of course, the tip jets. These have functioned extremely satisfactorily. The emphasis is in fact no longer on functioning as such, but on demonstrating reliability over a long period. The jets are entirely a Fairey achievement, developed at White Waltham airfield. After static trials, tests proceed on a rotating single-blade rig which reproduces centrifugal effects on air flow and fuel flow. The main problems concern stability over a wide operating range, light-up, and maintenance of high combustion efficiency. It is, of course, essential that relighting in flight should be a simple routine, and the first transitions in flight were preceded by ground tests which demonstrated this at the appropriate rotor speed.

The first phase of flight testing was with tip jets lit and covered speeds up to some 135 knots and altitudes up to about 5,000 ft. At low speeds—below about 60 knots—the propellers were maintained at fairly low thrust. This is necessary to avoid sudden yaw in the event of engine failure; the propellers need not be actually in the zero-thrust setting, but rather set so that yaw can be corrected by the application of differential propeller pitch from the rudder bar. Above this speed, as the air rudders become effective, the pilot normally applies increasing propeller thrust until at 100-120 knots the rotor power is at minimum setting, and while the tip jets remain lit most power is actually delivered from the propellers. Note that propellers are meanwhile in the "manual" regime, i.e., engine speed is controlled by a speed-sensitive governor on fuel flow and if the pilot demands more power from propellers or air compressors fuel is automatically increased.

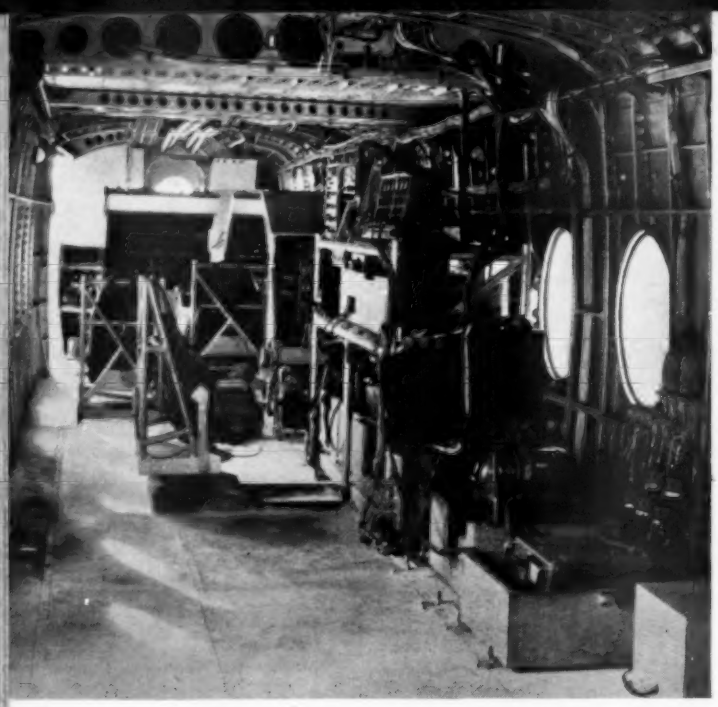
Under these conditions, while the air compressors are absorbing a fairly large amount of engine power, the rotor power is comparatively small as a result of the very weak fuel/air mixture employed. This is the stage therefore to effect a transition to complete auto-rotative flight.

The design problem is to ensure that the pilot has available a reasonable choice of control settings without excessive fuselage attitudes, rotor-flapping angles and so on, and also that his control movements to initiate a change of flight regime should always be logical. A very extensive wind-tunnel programme was directed towards this end. On the basis of the tunnel tests the pilot was given guidance on trim and manœuvre characteristics which proved most realistic.

In helicopter flight the problem is eased because the tip drive is available and the pilot is able to correct that most vital parameter—rotor r.p.m.—by using rotor power if necessary. In auto-rotative flight, however, rotor speed must be maintained by correct use of cyclic and collective-pitch controls.

Transition was therefore approached by easy stages. First

Despite the size of the Rotodyne its cockpit and instrument layout (above) is commendably simple; note the neat control arrangement. Right, this rig at Boscombe Down was specially built for the full-scale testing of power-plants, rotor and control systems.



Comprehensive instrumentation was installed in the Rotodyne's capacious fuselage for the flight test programme.

fuel was cut off from one pair of blades leaving only an air drive, the other pair meanwhile remaining lit. The jets were then relit and the operation repeated several times on each pair in succession. Next, again on one pair of blades, fuel was cut off and then the appropriate compressor declutched so that no gas drive remained. The compressor was then re-engaged and the jets relit. This process was repeated several times on each pair of blades. Finally, fuel and air were switched off first on one pair of blades, then on the second so that the rotor was in complete autorotation. The transition first took place in straight and level flight at about 5,000 ft. on April 10.

The first transition was clearly approached with caution. Apart from the need to confirm the relight performance of the tip jets it was also necessary to assess the trim changes on the airframe and to avoid momentary large flapping angles on the rotor blades. These items have in fact proved quite satisfactory and in general the wind-tunnel tests have been confirmed. In going through the transition a nose-down change of elevator setting is applied to keep the fuselage horizontal and the pilot is then free to accelerate in complete auto-rotative flight. In normal operation the step-by-step process will not, of course, be used. A single control, the so-called tip-jet lever, is moved to cut off tip-jet fuel and declutch both compressors. The clutch oil drains for some 15 sec., and over this period the pilot applies the necessary aerodynamic trim and change of propeller power.

At first, auto-rotative flight was in "manual" propeller control. As soon as the initial transition flights had been completed successfully a change-over was made to "interconnected" propeller control wherein engine speed is controlled by a speed-sensitive governor on propeller pitch—a normal c.s.u. in fact. This regime is then used for all cruising flight so that when flying with the rotor "windmilling" the power-control system is completely conventional.

A notable feature is that the fuselage vibration level in auto-rotative flight is low even at the highest speeds reached, i.e. some 140 knots at the present time. So far at least the rotor/wing combination has completely justified itself in this respect.

The immediate emphasis is now to extend the flight envelope in auto-rotative flight. The speed range will be increased and a wide range of rotor r.p.m. tested together with varying amounts of rotor-off loading. At a series of forward speeds it is therefore necessary to test various combinations of cyclic and collective pitch together with elevator angle to establish the acceptable range of control settings and also the optimum handling technique. The general trend, of course, is that as forward speed increases, off-loading also increases and the rotor speed is allowed to fall. Performance tests are also needed including a critical evaluation of fuel consumption. Present indications are that performance generally is considerably better than early estimates. In particular the rotor blades appear to have low profile drag.

Throughout the whole test programme a very large effort has been devoted to structural aspects. A comprehensive series of tests was made on rotor and airframe components in various fatigue-test machines and rigs. On the aircraft itself a large number of strain gauges are fitted both to the rotor and airframe, and the traces recorded in the fuselage. On every flight the indicators are monitored by an observer, and the records analysed before advancing to the next stage. The flight results are compared with the results of laboratory tests to ensure that adequate safety standards are maintained.

One major structural problem on all helicopters is ground resonance. This was investigated on a 1/15th scale dynamic model in association with theoretical analysis—much of this calling for original work. At a later stage the whole aircraft was subjected to tests designed to measure the distribution of stiffness and damping available, and this information was fed back into the model tests. Among the many vibration modes one combination of circumstances was found which was ground-resonance prone. The undercarriage was therefore temporarily rigged in an extended, rigid, condition, aimed to permit flight tests to continue at an early date. This temporary undercarriage, as predicted, was resonance-free; a redesigned retractable and resonance-free undercarriage will be fitted before very long.

A great deal of public attention has been directed towards helicopter noise, and the noise from the tip jets during take-off and landing needs to be reduced for those applications where the aircraft is to be used in built-up areas. However, as a

(*Continued on page* 777.)

An aerial view of the tip-jet test-rig site at White Waltham—which includes two rotor spinning enclosures.

(*Continued from page* 776)

mitigating effect the Rotodyne, subjectively, is completely free from the jarring components associated with some high-power jet engines, and in any case the jet noise is heard only for a very short time during take-off and landing; in cruise the noise level is very low. Notwithstanding this, Faireys have devoted a considerable effort to the reduction of tip-jet noise. The problem has been solved in principle. Various experimental silencers have been tested with very promising results and work is proceeding on the final product which will give minimum external drag and long life. The firm is confident that the final product will qualify for complete public acceptance even in the exacting inter-city applications.

The Rotodyne has begun its flying career very successfully. As on any large aircraft it is now necessary to demonstrate not merely that it functions well, but that it continues to do so with little maintenance over a long period. Nothing really impresses a user except an aircraft that fits his route pattern and earns as much money as possible in a fiercely competitive market. The firm is pressing on to overcome this final hurdle.

Rotodyne Flight Trials—The Pilot's Viewpoint

By Sqn. Ldr. W. R. Gellatly, A.F.C.*

SELDOM can the pilot of a new form of aircraft have started flight trials with such comprehensive familiarization as that given by the Rotodyne pre-flight proving programme. In the Jet Gyrodyne, under-powered and elementary though it was, we gained invaluable air experience in tip-jet behaviour and, particularly, in transitional handling from helicopter to auto-rotative flight, and back. John Morton and I made some 200 transitions both ways in this old aeroplane, and from the experience we were able to help with a practical guide in the layout of Rotodyne controls and to envisage quite accurately the drills we would eventually use.

In the six months before first flights the Rotodyne rig at Boscombe Down was in full operation. On this near-completely representative power-and-rotor system I had some 50 hours' "flying," getting to know its behaviour and formulating the operating drills. In many ways this rig was more valuable to us than a complete aircraft. Thus, by the time full-scale aircraft tie-down running began at White Waltham much of the handling was instinctive, and by the end of this final pre-flying phase I had a good idea of the likely behaviour in hover flight of all the power and controls systems, except yaw control —this was the only "unknown" handling feature before first flights on November 6, 1957.

The flight trials have followed broadly the classic pattern. From hovering work, in and out of the cushion, the speed and gentle-manœuvre envelope for helicopter flight was extended as quickly as strain-gauging clearance permitted, up to 130 knots and 7,000 ft. This then gave an adequate envelope in which to develop the techniques for early transitional flying.

For both aerodynamic and handling reasons we reckoned on the early transitions being made at about 5,000 ft. and 100-110 knots. In preparing for this our job was made easier by the power configuration of the Rotodyne, which allowed half-rotor operation (still with the two main engines operating) and a quick recovery to the full helicopter state if necessary. Therefore, after clearing normal jet operation up to 7,000 ft., we made numerous jet extinction and relighting tests by half-rotor, and then proved declutching and re-engagement of the auxiliary compressors, one engine at a time. In this phase, co-pilot John Morton looked like a theatre organist as he played the tunes for me on the rotor-power override switches.

By now we had proved the satisfactory air functioning of all the mechanisms used in transitions, both ways, and as a crew we were happy about our "normal" and "emergency" transitional flight drills.

Theoretically there are seven handling variables to be considered in transitions, but by consciously working on three only (wing angle-of-attack, rotor collective pitch and rotor longitudinal cyclic-pitch position) I found the remainder tended to look after themselves. The first few transitions were very quick "through and backs," made in slight descending flight to learn the technique of wing-incidence control without the added complication of changing thrust at that stage.

Once the technique was established full transitions both ways in level or gentle climbing flight were fairly simple manœuvres. Air speed in auto-rotative flight was then quickly increased to 140 knots to give a strain-gauge picture of a reasonable envelope for work in the next phase.

All flying up to this stage had been made in what we term the "manual regime," that is, manual control of collective propeller pitch, with the main engines constant-speeding through throttle governors. The next important step, therefore, was to change over in aeroplane flight to "interconnected" control of propeller pitch and engine speed through normal propeller governors. This was entirely satisfactory and immediately allowed much more latitude in thrust handling.

Now, as a complete rotating-wing aeroplane, with collective pitch fixed and controls used as on any two-engined fixed-wing machine, height was reduced in stages down to 1,000 ft., and the speed range of 100-140 knots was investigated at each stage.

Most flights to date have been with a take-off weight at the designed maximum for this prototype of 33,000 lb. The normal aircrew is two pilots, one power-systems observer and one strain-gauge operator. Instrumentation coverage (photo. and trace) has been comprehensive throughout, and good serviceability of equipment has caused only minor hold-ups to the flying programme.

Dr. Leason, who is in charge of development of the Rotodyne power systems, has flown as observer on all "new-stage" flights, and, with Mr. McKenzie (chief aerodynamicist) and Mr. Stepan (who is in charge of tip-jet propulsion development), has given help and advice that has been invaluable to me in the more difficult handling phases.

Until the stressmen have completed their sums the Rotodyne is still limited to 140 knots, though we are now cruising inside continuous power settings at that speed—nearly double the cruise speed of pure helicopters. Already we have cleared the worst of the handling hurdles, and, with reasonable confidence, it looks as if this "revolutionary" aircraft is going to fulfil all its design expectations.

*Senior helicopter test pilot, Fairey Aviation.

The Rotodyne in flight. It is powered by two Napier Eland turboprop engines driving auxiliary compressors to supply the rotor tip jets. The upper, sloping, fins of the tail unit hinge down when the aircraft is on the ground to clear the drooping blades.

New from Newbury

CURRENTLY in the news are the two new sailplanes which have recently been produced by Elliotts of Newbury, Ltd., to take part in the World Gliding Championships to be held at Leszno, Poland, from June 15 to 29.

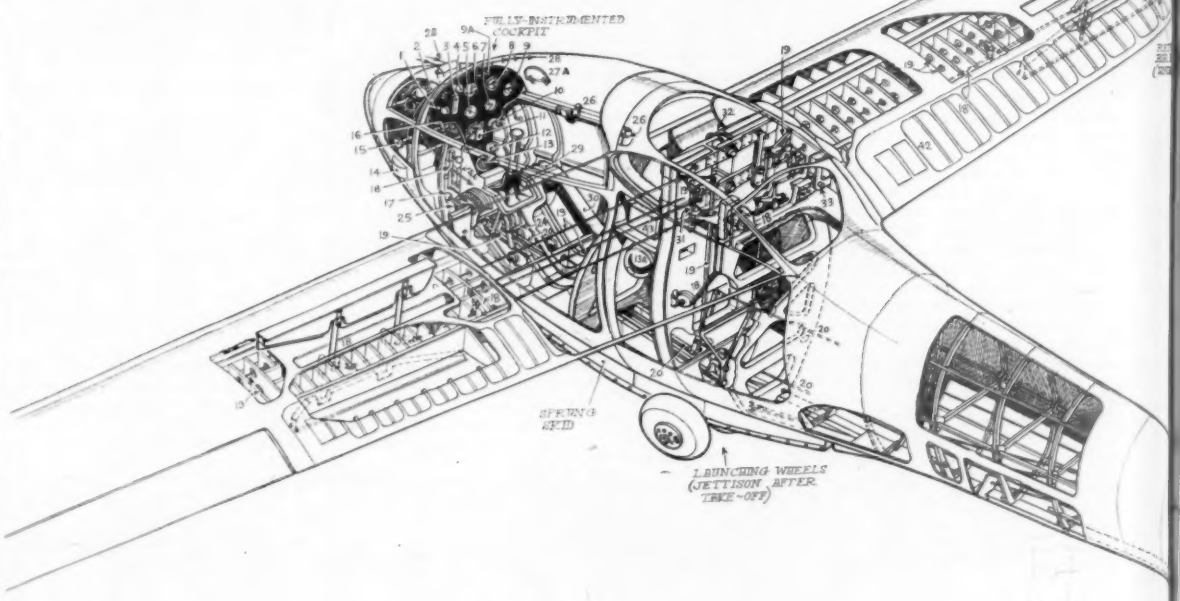
This well-known company began production of the Olympia sailplane just after the War, and six years ago started design work on a new version of this series, embodying the latest developments in the form of laminar-flow section wings to give better performance at higher speeds.

The first laminar-flow prototype, designated 401, had a 15-m. span wing, as on the standard model, and although it gave the expected performance at high speeds there was no improvement at low speeds. Consequently this prototype was modified to have a 17-m. span and became No. 402. This aircraft, after being flown by David Ince into second place in the 1956 British National contests, was lent to the U.S.A. team for that year's World Championships in France. It was flown by William Ivans who, without any practice or familiarization with it, gained fifth place; in fact he beat the two British team pilots who, in theory, were flying a higher-performance sailplane.

On the last day of the Championships Ivans, after making an exceptionally fine flight, was forced down into a ravine and No. 402 was written off.

Elliotts, having proved the new wings, which had given ideal flying characteristics, began producing another prototype, No. 403, which had similar wings, but had an entirely reconstructed tail unit to embody an all-moving tail with anti-balance tabs. No. 403 was finished two days before the 1957 British National

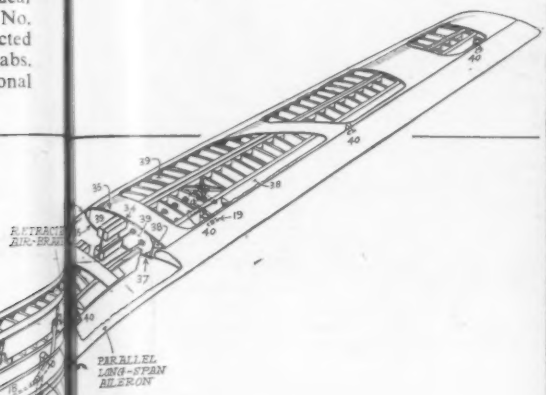
THE EoN SERIES IV
OLYMPIA SAILPLANE



KEY

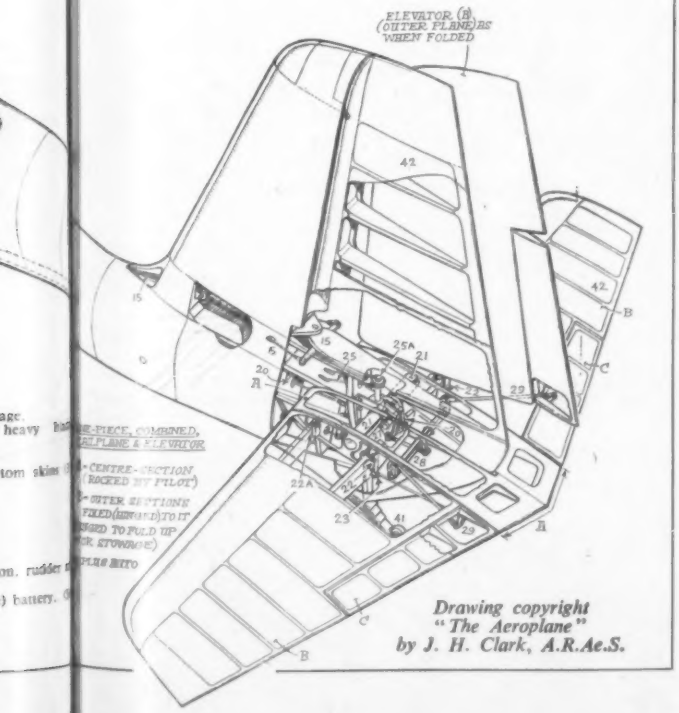
1. Tow release.
2. Capacity bottle (sealed-off, temperature-insulated air for variometer indicator (3)).
3. Variometer (connected to 14 on each side).
4. Switch for (6).
5. Altimeter.
6. Turn and slip.
7. Airspeed.
8. Variometer.
9. Artificial horizon.
9A. Two switches for (9).
10. Clock.
11. Compass (direct reading).
12. Oxygen gauge.
13. Oxygen regulator.
13A. Oxygen bottle.
14. Venturi for (3).
15. Rudder bars and cable runs.
16. Compass (E.2A).
17. Wheel-drop lever.
18. Air-brake runs.
19. Aileron runs.
20. Elevator runs, with cross-shaft 21 carrying centre-section "A."
22. Spar hinge (outer-plane "B" to centre-section "A") with pin 23 for folding.
22A. Front hinge-point.
24. Elevator stick stop.
25. Elevator hand/servo-tab hand-trim run via screwjack 25A on to crank 27, cross-shaft and arms 28, and universal-jointed rods 29 to tab "C."
26. Detachable canopy locking and register-pins.
27A. Direct-vision panel (actually on port side).
28. Demisting air-intake and air stream, and ventilator.
29. Battery.
30. Seat.
31. Wing spar attachment to fuselage.
32. Wing-to-wing pinning (with heavy bolts grouped close in to centroid).
33. Rear-spar fix to fuselage.
34. Main-spar section, top and bottom skins butt jointed at nose-piece 36.
37. Rear spar.
38. Aileron shroud.
39. Solid ribs.
40. Aileron hinges.
41. Sprung tailwheel.
42. Fabric-covered portions of aileron, rudder and elevator.
43. Venner lightweight (silver-nitrate) battery. (See 13A.)
44. Inverter (see ahead of stick).

TWO OF A KIND.—In these pictures, taken from a Tiger Moth, the two EoN Series IV Olympias are seen in formation—the 419 on the left—after an aero-tow launch from Lasham. In the upper picture the shorter span of the 415 (G-APLS) on the right is apparent.



TECHNICAL DATA

	419	415
Span	62 ft.	49 ft. 2 in.
Length	26 ft.	24 ft. 6 in.
Wing area	186 sq. ft.	161 sq. ft.
Empty weight	606 lb.	550 lb.
Loaded weight	850 lb.	820 lb.
Estimated gliding angle ..	1 : 38	1 : 35



Drawing copyright "The Aeroplane" by J. H. Clark, A.R.Ae.S.

championships. Tony Goodhart flew it, and although he was unable to have any practice with it, was placed third. Actually, if every contest day had counted he would have finished second.

The company enterprisingly felt that, although the combination of laminar-flow wings and the new tail unit had been proved, a still-better design was within their capabilities. In October, 1957, they offered to build and lend to the British team another prototype, having an even larger span—19 m.—which appeared to be the optimum for performance embodying all the features that had been proved in the preceding four years.

The offer was accepted by the British Gliding Association, and the new aircraft—No. 419—was flown by David Ince on March 29 of this year.

Comparative tests were later made against another British sailplane. These tests showed that the performance of the 419 was fully up to expectations and that the new sailplane was an extremely efficient type. On April 13 Ince set up a U.K. distance record of 315 miles, flying from Lavenham, Suffolk, to Land's End. Unfortunately he did not quite make his declared goal of Land's End aerodrome, landing two miles north, otherwise he would have gained a goal-flight record, too.

The rules governing this year's World Championships provide for an open class, which means that sailplanes of any type, size and price can compete. There is also a restricted class, limited to 15-m. span aircraft, and in some respects details of construction, equipment, etc. The idea of the restricted class is that pilots will fly against each other in more-or-less uniform aircraft, and piloting skill will count more than in the open class, where wing span and other relative factors will allow much higher performances. So the aircraft is as important as the pilot's skill.

The British team is to fly two aircraft in the open class and two in the restricted. Tony Deane-Drummond and Nick Goodhart will be in the open class, with Philip Wills and Tony Goodhart in the other.

A variation of the 419 is the 415, an offer by Elliotts to produce which was also accepted by the B.G.A. It is specifically for the restricted class and has a 15-m. span and is to be flown by Tony Goodhart. The prototype was first flown by David Ince on April 27 this year.

THE FIGHTING SERVICES

VALIANTS AT VALLETTA.—Last month the NATO air/sea Exercises "Medflex Fort" and "Medship Bastion" took place in the Mediterranean. A number of R.A.F. units participated. Crews and aircraft from three squadrons that were based in Malta are shown on this page.

Sunderland Service Ending

BASED at Seletar, Singapore, the last remaining Sunderlands in the R.A.F. are now on their way out of service. The impending doom of the Sunderlands in No. 205/209 Squadron (Wg. Cdr. R. A. N. McCready) was recorded in the R.A.F. 40th Anniversary issue of THE AEROPLANE (March 28, 1958) and their replacement has begun with the arrival of the first Shackleton at R.A.F. Changi last month.

The first Shackleton for No. 205/209 Squadron was flown out from R.A.F. Aldergrove via North Africa, Aden and Ceylon by Wg. Cdr. McCready. Replacement of the Squadron's seven Sunderlands with Shackletons is expected to be completed by September.

From the start, the first unit of the Far East Air Force was equipped with flying-boats, and when the last Sunderland leaves R.A.F. Seletar it will end an association with the Command dating back 28 years. The first F.E.A.F. unit, No. 205 (Flying-Boat) Squadron, was formed at Seletar in January, 1929, from the Far East Flight which previously had flown Supermarine Southamptons from England to Australia and back to Singapore.

Besides the R.A.F., the French Navy and the R.N.Z.A.F. still operate Sunderlands. No. 205/209 Squadron's Sunderlands first flew in October, 1937, and started squadron service in the summer of 1938.

Commonwealth Pilot Training

WITH the transfer of the R.A.A.F. Advanced Flying Training School from Point Cook, Victoria, to Pearce, Western Australia, last month, the R.A.A.F. has taken the first step towards jet-pilot training. From the date of the move the C.A.C. Wirraways are being replaced as the advanced trainers by D.H. Vampires, making jet training part of the standard flying course at the school.

Basic pilot training will continue at Uranquinty, N.S.W., on C.A.C. Winjeels, and the movement of flying training to Western Australia means the end of an era at Point Cook. The station has been the "seat" of air force pilot training since the first four-man course of Australian military pilots began there on Bristol Boxkites in August, 1914.

Reunion

Coastal Command.—The officers' annual reunion will take place in the Officers' Mess, Headquarters, Coastal Command, R.A.F. Northwood, Middx., on June 14. All officers who have served in the Command since September 2, 1939, are eligible to attend, and tickets, price 15s., may be obtained from Wg. Cdr. P. A. Ostle at R.A.F. Northwood.

Top left, a Valiant crew of No. 543 Squadron about to embark on a sortie from Luqa.

Lower left, a No. 120 Squadron crew disembarking from their Shackleton 2 after a 13-hr. patrol over the eastern Mediterranean.

Below, Wg. Cdr. A. C. Blythe, O.C., No. 12 Squadron (second from left) and his crew talking with Sqn. Ldr. H. F. McNabb, "A" Flight Commander.

Photographs copyright "The Aeroplane"

A Century and a Half of Power

D. Napier and Son, Ltd., is celebrating its 150th anniversary. JOHN W. R. TAYLOR *tells the story of its beginnings and its achievements, particularly in the aeronautical field.*

A HUNDRED years old when flying began in this country, the company made a particularly auspicious entry into the industry. Its first aero-engine, the Lion, was for 10 years the undisputed leader of its class. Its Sabre, partnering the Tempest, ended World War II with many successes to its credit. The company's justifiable pride in these two engines is symbolized in its badge, which embodies a lion wielding a sabre.

The story of D. Napier and Son, Ltd., is less well known than that of any other major company in the British aircraft industry, which reflects the temperament of the three generations of very remarkable men who ran the company as a family business for about 120 years. Believing that good products sold and advertised themselves, they abhorred direct contact with anyone but their customers, to the extent that one of them objected even to giving details of his business to H.M. Inspector of Taxes. However, the story started long before that . . . .

It was back in 1908 that the founder of the company, David Napier, took the route to England that is traditionally the Scotsman's noblest prospect. As his father was smith to the Duke of Argyll he must already have had some knowledge of engineering. This would explain why he spent only a few months in the Lambeth works of the great Henry Maudslay, pioneer designer of the modern lathe, before setting up his own business in a small workshop in Lloyds Court, St. Giles.

There was no lack of opportunity then for a young man of 23 with engineering ability, because the Industrial Revolution provided an insatiable demand for new machinery to take the place of men or to enable them to do their jobs more efficiently. Napier himself was no lover of mass-production and maintained throughout his life a high degree of craftsmanship and hand-built techniques in his factory; but he quickly acquired a reputation as a designer of equipment for people who were.

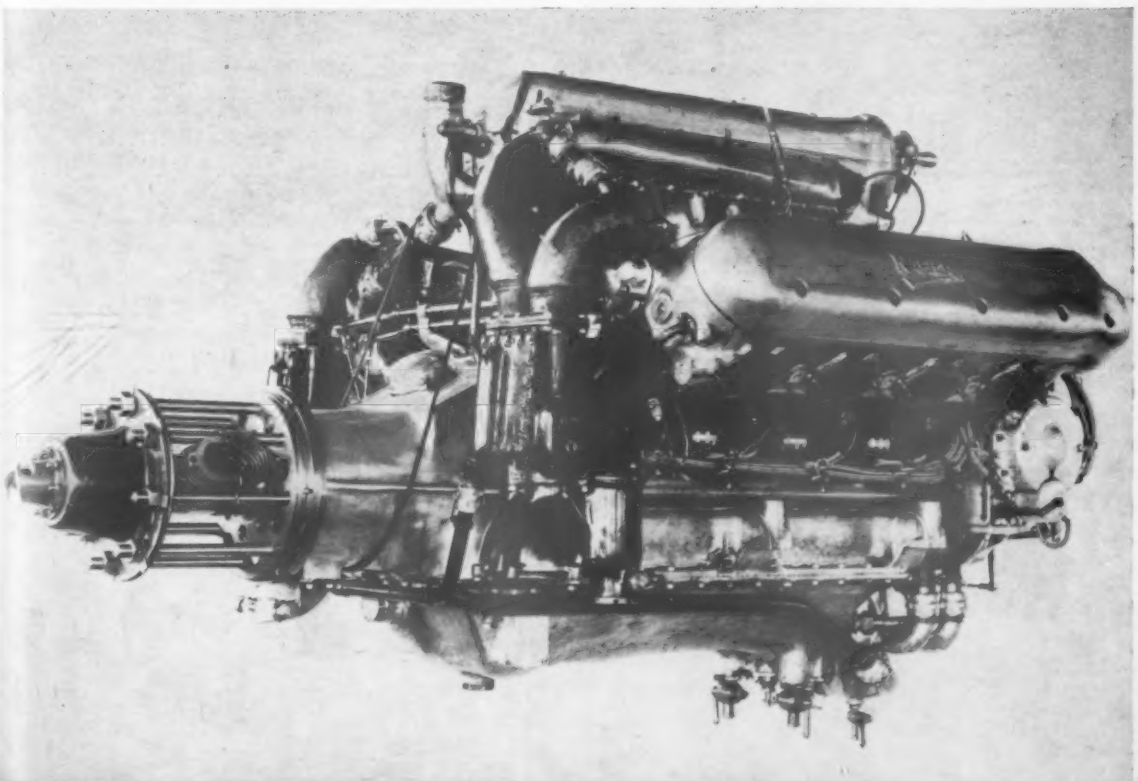
One social result of industrialization had been an increase in the public demand for newspapers and books; so he decided to specialize in the design and manufacture of printing presses. Although *The Times* caused a sensation in 1814 by switching over to steam-driven machinery, which increased output from 250 sheets an hour to about 1,800, the "Nay-Peer" (!) machines which young David Napier supplied to T. C. Hansard, the Parliamentary printer, were turned manually by two men. Their great attraction was that they made possible for the first time a really precise register, and before long his presses were turning out newspapers and fine printing in places as far away as New York.

Prosperity necessitated a larger factory. By 1836 he had transferred his works to Lambeth, on a site about where Festival Hall now stands, and by the middle of the century was employing 200-300 people. He brought his 14-year-old son, James Murdoch Napier, into the business in 1837 and took him into partnership 10 years later, since when the company has been known as D. Napier and Son right up to the present time.

Printing machinery continued to be one of its main products after the move, but David Napier's keen eye saw ways of improving almost everything mechanical, and an incredible variety of equipment left his workshops, which were among the finest in London.

His first contact with the arms industry came when the Board of Ordnance chose a German rifle to equip the Army with and decided that it could be used to full effect only if the quality of bullets was improved. Up to that time bullets had always been cast and invariably contained blow-holes which made them lighter and less accurate than they should have been. Napier devised a machine—again hand-operated—which rolled and pressed out bullets at the rate of 25,000 a day.

It was, if anything, too good, because the Board of Ordnance told him that they wanted to put his machinery into Woolwich Arsenal and produce the bullets themselves. He refused to



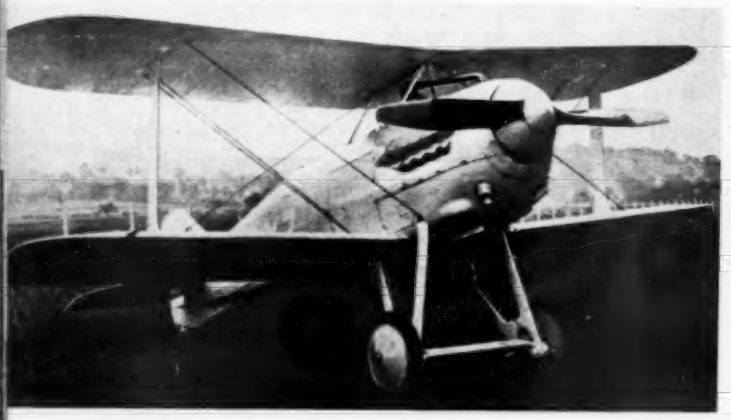
The direct-drive Napier Lion of 1925 developed 525 b.h.p. for a dry weight of 920 lb.

reveal the secrets of his design until asked to do so by a member of the Royal Family. Even then he first took out a patent for it, which stood him in good stead later when bullet-making machines were ordered by several foreign countries, including Egypt and France.

From bullets Napier turned to other armaments. He supplied the first steam-driven gun-finishing machinery ever installed at Woolwich, the fame of which soon brought many orders for similar equipment from Spain and Russia.

Although he was nine-tenths engineer and only one-tenth businessman he soon realized the advantages of Government contracts compared with others in terms of security; and more and more of the company's products went to official and semi-official customers.

Above, a Lion engine powered the Supermarine Sea Lion II which won the Schneider Trophy contest of 1922.



Above, in 1922 the Gloster Bamel (or Mars I) achieved 212 m.p.h. on a 470-h.p. Napier Lion.

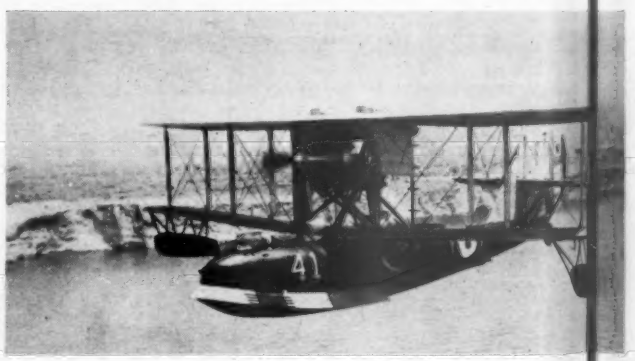
There were exceptions, such as an "improved steam carriage," which might have lived up to its name had it worked, a peat compressor for an Irish landlord, and an early ancestor of the Decca Flight Log which kept a continuous automatic record of the course of a ship over each 24-hr. period; but these simply reflected the old man's love of tackling entertaining projects.

More typical of Napier's work at this time was the extremely accurate coin-weighing machinery which he supplied to the Bank of England, the Royal Mint and to foreign mints. There were various models, some of which did no more than reject underweight gold coins, while others inspected blanks and automatically trimmed any that were overweight. Proof of their reliability is that one of the weighing machines is still used occasionally at the Royal Mint during rush periods.

The rapidly growing railways were also good customers for hydraulic equipment and cranes; while James Napier's first big job was to design under Admiralty contract equipment for weighing stone and registering the results. This was used, along with numbers of the company's tipping trucks, in the construction (by convict labour) of Portland Breakwater.

Unfortunately, although James inherited his father's inventiveness he was even less of a businessman, and when the old man finally retired in 1866 the company soon began to fall apart. By the '80s the once-efficient workshops were full of dusty, rusty equipment. Only seven persons worked there, producing enough printing, coin-sorting and stamp-perforating machines to keep the now-ageing Napier in reasonable comfort while he devoted his still-active mind to inventions that were more eccentric than practical.

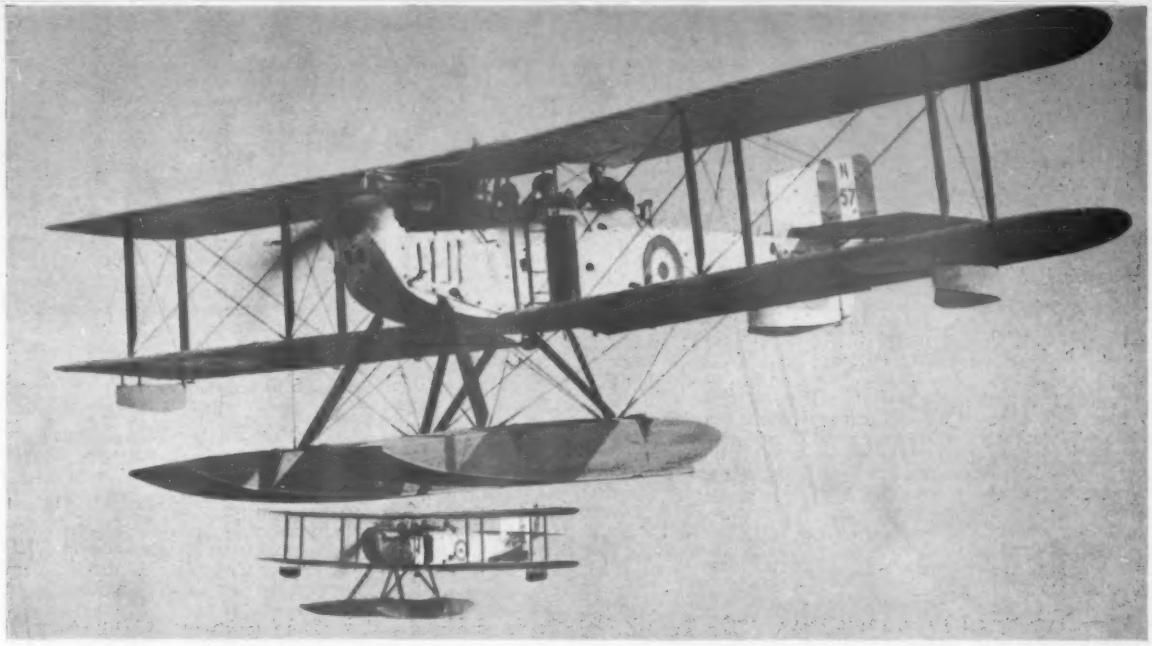
Such was the state of affairs in 1895 when James died and his youngest son, Montague Stanley, bought from his brothers the once-great business of D. Napier and Son. He, too, was inventive, and the large-wheeled skates which he made for people who wanted to go a long way in a hurry is one of the



Above, a Lion-powered Supermarine Seagull III amphibian used by the Fleet Air Arm in the early 1920s.

Below, left, the D.H.4R was a special racing conversion of the D.H.4 day bomber. Fitted with a Lion engine it won the 1919 Aerial Derby.

Below, a Napier Culverin Diesel engine was fitted experimentally to a Fairey IIIF.



Lion-powered Fairey IIIDs, on wheels or floats, were used extensively by the R.A.F. between the Wars. Those seen above are of No. 202 Squadron, flying over Malta.

attractions at a display of Napier products now in the Tea Centre, Regent Street, London.

He needed to put on some metaphorical skates himself to save the rapidly dying business. By a rare stroke of good fortune, or shrewdness, he decided after two or three years that, just as his grandfather had floated the company's fortunes on the flood tide of the Industrial Revolution, so he would rebuild them by turning to the new revolution in transport represented by the motorcar.

It was a gamble, because cars were then the expensive sport of the rich, only recently freed of the abominable restriction of being preceded by a man with a red flag, and still built for the most part in France. But fate was kind, because the one vital quality that the company had always lacked—hard, efficient salesmanship—was injected simultaneously by the arrival on the scene of one Selwyn Edge.

The two men had first met as racing cyclists in the Bath Road Club, and their business partnership was forged when Edge persuaded Napier to abandon the car which he had designed and to start by improving the already established Panhard-Levassor, one of which Edge owned. Napier agreed, and soon the car's tiller steering had been replaced by a wheel and its solid tyres by pneumatics.

Next he directed his attention under the bonnet, designing and building a two-cylinder vertical engine which produced about 8 h.p. for a weight of less than 3 cwt. Although he could not have realized it at the time, in so doing he changed the whole course of the company's future progress, because power-plants for cars, aeroplanes and boats have formed the basis of almost all subsequent Napier production activities.

The partnership between Napier and Edge seems to have set the pattern for the later collaboration between Henry Royce and Charles Rolls which led to another great aero-engine company. While the two engineers built cars of superb quality, Edge and Rolls not only sold them but helped to prove their capabilities.

In 1900 Edge won a £50 wager by driving a Napier car up the notorious Porlock Hill in Somerset, which has gradients of one in four. He won competitions and set up records. Even more important, his salesmanship helped to raise the company's profits from £19 in 1900-01 to over £18,000 four years later.

By then D. Napier and Son had outgrown the Lambeth works and was installed in a fine new factory at Acton, which has remained its headquarters ever since. The payroll had grown to the unprecedented total of 500 employees, who worked hard to keep pace with demands for cars, taxi-cabs and commercial vehicles. Within two more years the number of employees doubled again.

Most famous of the cars were the great six-cylinder models which developed up to 90 h.p. and cost anything up to £2,000

More Lion-engined types. Left, the Handley Page Hyderabad; below left, the Blackburn Ripon (the prototype is shown), and, below, the Vickers Virginia.

each. One of them was driven over Daytona Beach at 104.65 m.p.h. in 1905, a World record at the time; and possession of the production version gave its owner the kind of social status reserved today for Rolls-Royce owners.

Business was so good in an age of elegance that when D. Napier and Son, Ltd., became a public company in 1912, Montague Napier was able to subscribe 98% of the ordinary capital. Shortly afterwards, following a disagreement, he took over control of Edge's company, from whence came his two fellow directors, H. T. Vane and W. H. White.

Plans were made to offset a decline in sales that year by concentrating on cars in the middle-h.p. bracket; but before these could be put into effect Britain was at war with Germany.

Although production of Napier cars continued on a small scale until 1917, and an attempt was made to resume production in the early '20s, the outbreak of the 1914-18 War brought to an end the company's era of leadership in the motoring world. The factory at Acton was kept going throughout the remaining months of 1914 and in 1915 by switching to the manufacture of vans, lorries and ambulances for the War Office; but its future was linked with yet another great trend in World affairs—the revolution in warfare brought about by military aviation.

This third part of the company's history, beginning in its 107th year, marked also the beginning of the end of its domination by the Napier family. On August 2, 1915, the Government declared the Acton works a "controlled establishment" under its new Munitions of War Act, which enabled it to use the factory for whatever purpose was considered most beneficial to the war effort. The immediate result was that the company found itself in the aircraft business, with large orders for R.E.7 and R.E.8 airframes and R.A.F.3a and Sunbeam Arab aero-engines.

Montague Napier was none too pleased when the Arab developed serious teething troubles, and offered to produce the prototype of a better engine at his own expense on the understanding that he would receive royalties if it were ever built in quantity. This was agreed in mid-1916, but in the following year he became seriously ill and decided to spend the rest of his life in the warmer climate of France. In this also his life strangely paralleled that of his great competitor, Sir Henry Royce.

Although far away from Acton and, by 1918, no longer a controlling shareholder in the business, he continued to have a strong influence on the company's policy until his death in 1931 and maintained the agreement granting him royalties on engines which he designed, rather as though he were a private consultant.

Meanwhile that first aero-engine which he had financed privately, and which had been designed in detail by A. J. Rowledge, had taken shape as the Lion, a 12-cylinder water-cooled engine with three banks of cylinders arranged as a broad arrow. It was outstanding from the start, and the vast total of almost £2½ million worth of orders held by Napier in 1918 included a Government contract for an initial production batch of 100 Lions.

These were just too late to take any part in the War and when military contracts were cancelled ruthlessly after the Armistice the Lion might easily have ended up as the power unit of a few D.H.9As and nothing more. Certainly H. T. Vane and Rowledge tried to persuade Montague Napier to forget aero-engines and get back into the car business. They told him that Sefton Brancker, just appointed as Director of Civil Aviation, had said there would be no big aviation business for five years.

Napier agreed reluctantly that they might try to regain their pre-War position in the motor industry by putting their costly new six-cylinder car into production, but he believed

The Gloster VI, with a special Lion VIID, was produced for the 1929 Schneider Trophy contest. It achieved 336.3 m.p.h. over a 3-km. course.

that the day of the high-priced car was past. Aero-engines, on the other hand, were ideal products for a firm like Napier, because engineering quality and workmanship were so important that high price was a secondary consideration. So he suggested that they should also start an assembly line of 300 Lions.

It was an act of great courage and imagination. At the same time, he prepared against any bad times ahead by ensuring that a high proportion of the profits made in the '20s should be put into gilt-edged investments. The company had good reason later to be grateful for both moves.

The new car failed to sell in a post-War world hungry for small cheap mass-produced vehicles. But in 1920 Napier was able to claim in its advertisement in "Jane's All the World's Aircraft" that the Lion was "judged by performances the best in the World."

Among other achievements, the advertisement recalled that the Lion was the first to reach a height of six miles; winner of the 1919 Aerial Derby race; first to fly non-stop from London to Madrid, covering the 900 miles in a record 7¾ hr.; first to carry a load of 1½ tons to 13,999 ft.; and holder of 24 British records for speed, duration and load-carrying. It ended by quoting the view of the *Automobile Engineer* that the Lion "is lighter per H.P. than any other aero-engine yet produced."

In its initial production form this engine gave 450 h.p. for a dry weight of 900 lb. Its main attraction was that it packed this power into a compact shape only 4 ft. 8 in. long, 3 ft. 6 in. wide and 3 ft. high. When installed in a D.H.9A it gave it a top speed of 134 m.p.h., compared with 120 m.p.h. for the Liberty-engined version, and made possible the unofficial record climb to 30,500 ft. in 66 min., which exceeded the official record by over 50%.

This was but the start of a glorious record of service that made the Lion the outstanding British aero-engine of the '20s. Its success was limited only by the Government's restriction on the purchase of new aircraft for the R.A.F., in the seven years that followed the "war to end wars." Despite this, no fewer than 35 of the 73 British aircraft described in the 1924 "Jane's" were Lion-powered.

It is impossible to refer in so short a space to every aircraft fitted with Napier engines or even to all the outstanding flights that they made. A remarkably-detailed list compiled by the Napier publicity staff shows that at least 131 British and three foreign "one-off" and experimental types have had Napier powerplants, in addition to 28 British and four foreign designs that were built in quantity.

The types built in quantity include the following, with the number built, where available, indicated in parentheses: Avro Bison (41); Blackburn Dart, Velos, Ripon and Firebrand II; D.H.9A, D.H.14 and D.H.34 (11); Fairey IIID (over 280 of three versions); Fawn III (70), IIIF (609 of 11 versions) and Seafox; Handley Page Hyderabad (45), W.10; Hereford (100 ordered); Hawker Hector (178); Typhoon (3,330 Gloster-built of four versions); Tempest V (800 of two versions) and Tempest VI (142); Percival Gull 4 Series II (22); Spartan Arrow; Supermarine Sea Eagle, Seagull and Southampton (78 of two versions); Vickers Vernon (55), Virginia (126) and Victoria (96); Westland Walrus (36); Dornier Wal; Fokker F.VII and T.III; and Heinkel H.E.5 (Swedish-built).

An idea of the part played by the Lion in the company's history is given by the fact that all but nine of those 32 types were powered by this engine. The exceptions are the Gull 4

(*Continued on page* 785)

Another Schneider Trophy type with a 670-h.p. Lion engine was the Gloster IIIA of 1927.

(*Continued from page* 784)

and Arrow with Javelins; the Seafox with a Rapier; the Hereford and Hector with Daggers; and the Firebrand II, Typhoon and Tempest V and VI with Sabres.

All the ingenuity and precision that had characterized Napier products for generations were built into the Lion, which quickly established a reputation for reliability besides performance. By 1926 Lion-engined commercial aircraft flown by Imperial Airways and its private-operator predecessors had amassed a total of more than 2,000,000 miles of flying.

In that same year, the R.A.F. made the first of its series of annual training flights with single-engined Fairey biplanes from Cairo to Cape Town and back. On this occasion, Lions bore the formation of four IIIDs with never a falter over what was still a pioneer route, arriving back in Egypt in such fine fettle that the aircraft were at once fitted with floats and ferried back to Lee-on-Solent. Each had by then flown 13,901 miles without mechanical failure of any kind.

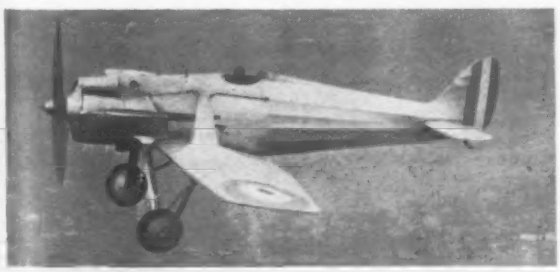
Similar Cairo-Cape flights were made by IIIFs in 1927, 1928, 1929 and 1930. Later exploits included a Heliopolis-East Africa return operation led by Wg. Cdr. A. T. Harris, now better remembered as the wartime A.O.C.-in-C. of Bomber Command.

Even longer flights were made by R.A.F. flying-boats in this period, including the famous 27,000-mile cruise by four Lion-engined Southamptons of the Far East Flight, led by Gp. Capt. H. M. Cave-Browne-Cave in 1927-28. In what was undoubtedly the finest piece of organized formation flying ever seen up to that time they flew from Plymouth to Singapore, round Australia, back to Singapore, on to Hong Kong and then back once more to Singapore. Their troubles were limited to barnacles which collected on their hulls in some harbours, tar which oozed from refuelling lighters on to their immaculate white paint and a faulty Primus stove.

Lions also had their share of operational flying in the 1920s and 30s, when the R.A.F.'s commitments throughout the still-British Empire kept it permanently at war somewhere or other. Their reliability was never more valuable than during the evacuation of non-combatants from Kabul in 1928-29, when 586 persons were flown out of the besieged city, mostly in Vickers Victorias, over mountains 10,000 ft. high during one of the severest winters on record, in territory which offered no hope of a successful forced landing.

Records also fell to the Lion by the dozen. In 1919 it enabled Capt. G. Gathergood to win the Aerial Derby in a reduced-span D.H.4R at a speed of 129.38 m.p.h. Two years later Glosters decided that the only way to interest potential customers in their products was to build a really fast super-streamlined racer that could be put forward as the prototype for a fighter. Within three weeks the new aircraft—known as the Mars I or Bamel and powered by a 470-h.p. Lion II—was designed, built and flown to victory in the 1921 Derby by Jimmy James.

Its speed of 163.34 m.p.h. was only 3 m.p.h. short of the British speed record, which it beat decisively a few months later by clocking 196.6 m.p.h. over a measured course. This



Above, the D.H. 77 interceptor with a 300-h.p Napier Rapier; below, the Lion-engined Fairey Long Range Monoplane which gained the World's distance record of 5,309 miles in 1933, and, below right, the Blackburn Iris II used as a test bed for Culverin engines.

The Supermarine S.5, with a special racing Lion, of 1,000 h.p., won the 1927 Schneider Trophy contest at 281.65 m.p.h.

was but a start, because in successively improved versions it won the Aerial Derby again in 1922 at 177.85 m.p.h. and in 1923 at 192.4 m.p.h., in the meantime establishing a new British speed record of 212.2 m.p.h.

Even more spectacular and important were the successes achieved by Lion-engined aircraft in the Schneider Trophy contests. Henri Biard's 1922 victory in a Supermarine Sea Lion flying-boat (475-h.p. Lion II) kept the contest alive when it seemed the Trophy would be won outright by Italy. Three years later the same pilot flew the S.4 (700-h.p. Lion), first of R. J. Mitchell's revolutionary monoplane Schneider racers, to a new British speed record of 226.75 m.p.h.; and although this little seaplane was destroyed by wing flutter before the race it pointed the way to the S.5 (875-h.p. Lion VIIB) of 1927 which gave Britain the first of the three victories that won the Trophy outright. In doing so the S.5 also set up a new international 100-km. speed record of 283.66 m.p.h.

The power quoted above for the Lion VIIB indicates the enormous "stretch" that Napiers had built into their first aviation venture, and represented by no means the limit of its potential. Indeed, the Lion VIID fitted to the beautiful Gloster VI Schneider seaplane of 1929 gave no less than 1,320 h.p., enabling Flt. Lt. George Stainforth to set up an unofficial World's speed record of 336.3 m.p.h. Yet it still measured only 5 ft. 5 in. long, 37½ in. wide and 34 in. high.

In distance as well as speed the Lion set the pace for many years. It powered the twin-engined Dornier Wal in which Commandante Franco made the first non-stop crossing of the South Atlantic, and the Fairey Long Range Monoplane in which Sqn. Ldr. O. R. Gayford and Flt. Lt. G. E. Nicholetts set up a World's record by flying non-stop 5,309 miles from Cranwell to Walvis Bay, S.W. Africa, in 1933.

Long after it ceased to be used in first-line combat aircraft it continued to break records on land and water. In 1929 Sir Henry Segrave pushed the land speed record to 231.3 m.p.h. in his Lion-powered Irving car. Two years later Sir Malcolm Campbell's Lion-engined Bluebird achieved 246.08 m.p.h., and then 253.968 m.p.h. in 1932. On water Hubert Scott-Paine set a World's record of 110.102 m.p.h. for single-engined boats in "Miss Britain III" in 1934 as the climax to several years of high-speed research, the results of which were built into his later R.A.F. rescue boats, which were similarly Lion-powered.

Meanwhile John Cobb had entered the scene, setting up countless class and track records in his great Napier-Railton Special before attacking the World's land speed record in 1938. The car he used had a one-piece metal shell, the streamlined shape of which was broken only by blisters over the driver's head and the wheels. Its power came from two Lions, which raised the record to an incredible 350.20 m.p.h.

Even this was not good enough for Cobb, and after the War in 1947 he had the same car fitted with two Lions specially boosted to give 1,480 h.p. each—well over three times the rated power of the original engine of this design. In setting up a record of 394.196 m.p.h. which still stands 11 years later,

he became during one of his runs the first man ever to travel at over 400 m.p.h. on land. It is interesting to note that this must be faster than any Lion ever travelled in the air.

When the Lion began its record of successes, the Napier company was hard at work trying to find an equally successful and efficient new engine to follow it into production. Unfortunately the choice was hampered by the Government's uncertainty about what it wanted or even if it wanted anything at all; by the fact that the company could not afford to develop more than one engine at a time, whereas its competitors were able to underwrite success with a range of three or four different models; and by its own traditional lack of salesmanship, which left its directors quite happy to continue producing their engines for a single "safe" customer—the Government.

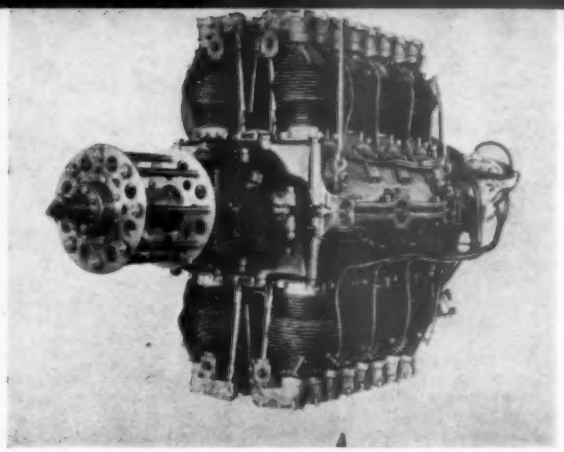
Like most other people in the aviation business, they had expected a tremendous boom in flying after the 1914-18 War and thought there would be a ready market for an engine giving more than twice the power of the Lion. So they set to work designing and building a great 16-cylinder "X" engine known as the Cub, which eventually produced 1,000 h.p. for a weight of 2,450 lb.

Impressed by the possibilities of this engine, which was believed to be more powerful than anything else on the stocks at that time the Air Ministry ordered six prototypes in September, 1919, at a cost of £10,000 each. They powered two equally huge single-engined aircraft, the prototype Avro Aldershot bomber (J6852, intended mainly as a flying test bed) and the Blackburn Cubaroo (N 166) torpedo-carrier, which was the largest single-engined aeroplane of its day with a span of 92 ft. and warload of 1½ tons.

Inevitably the Cub ran into teething troubles: in particular its performance fell off too quickly at altitude. However, this could have been remedied and the real reason for the Air Ministry's decision to cancel further development was that it did not fit in with its immediate needs. The whole concept of a bomber with one large engine, as opposed to the usual twin installation, was seen to be wrong when so many overseas commitments were in countries where forced landings spelled disaster. The R.A.F. received instead the Virginia and Hyderabad night bombers, each with two Lions.

The 470-h.p. Lioness (Lion-S = supercharged) of 1925 was no more successful. It was basically a Lion modified to work in an inverted position, so improving the lot of pilots who found that the Lion's broad-arrow shape cut off rather a lot of the forward view when landing a single-engined machine. A standard production Fawn III was modified into a flying test bed under specification 1/25, becoming the Fawn IV (J7768), but by the time it flew the Air Ministry had already decided that the expense of replacing a perfectly satisfactory engine was not justified.

Napier found itself once more without an engine to follow the Lion, production versions of which continued to progress steadily under development through the 500-h.p. Lion VA of 1924 to the 525-h.p. direct-drive Lion of 1925, 540-h.p. Lion XI of 1927 and 555-h.p. Lion XV of 1932. Plans to develop an



Napier's Rapier air-cooled 16-cylinder H engine developed 395 b.h.p.

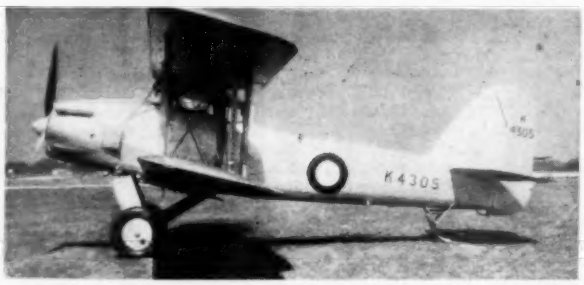
800-h.p. engine to fill the gap between the Lion and Cub were abandoned when word was received that the Air Ministry would be much more interested in a fighter powerplant that would give a normal 250 h.p. and 400 h.p. when supercharged.

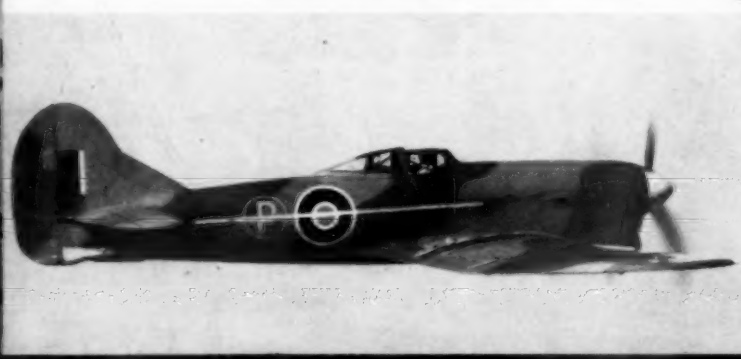
An eight-cylinder engine to meet this requirement was put in hand, along with a 12-cylinder unit using basically the same components and intended to meet the competition of the 670-h.p. Rolls-Royce Condor. By 1928 it was clear that neither engine was likely to save the day, and although it must have caused Montague Napier considerable anguish to surrender his last hold on the design of the company's products, he was far-sighted enough to agree that an outside designer should be called in.

The choice of Frank Halford for the job was one of the best decisions ever made. At the time, there was a marked trend away from water-cooling to the simplification and weight-saving offered by air-cooled designs, and Halford's already fine reputation had been enhanced by the splendid little air-cooled Cirrus and Gipsy engines that he had so recently designed for the Moth.

It was quite apparent that some years would elapse before any practical financial results would accrue from Halford's main work, which was restricted by his agreements with other companies to engines of between 404 and 718 c.c. capacity. So, in something of a panic, Napier decided to spend £50,000 on developing an air-cooled six-cylinder in-line engine for light-planes and to try to get into the new Diesel market by obtaining licences to build engines of the latter type designed by Packard, Treiber or Junkers.

In due course, these negotiations produced an agreement with Junkers which led to the 515-535-h.p. Cutlass (licence-built Jumo 5) and 720-h.p. Culverin (Jumo 4) Diesels of 1934; but



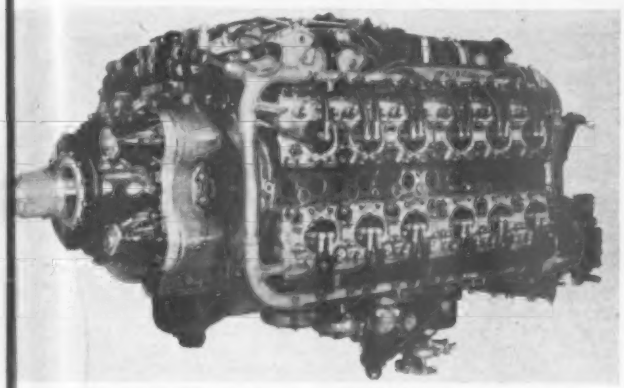


Above, the Rapier-powered Fairey Seafox; right, a Hawker Tempest (Sabre engine) with ducted spinner; below, a prototype Tempest, Sabre-powered, and, below right, the Martin-Baker MB-2, which had a Dagger.

apart from the trial installation of three Culverins in a Blackburn Iris flying boat (S1593), and one in a Fairey IIIF (K1726) for evaluation by the R.A.E., they did nothing to fill the gap.

Finally, Napiers decided they had no alternative but to try to get back into the motor trade. An attempt to buy the Bentley company was defeated by the higher bid of Rolls-Royce; but work was started on the design and manufacture of "mechanical horse" tractors which seemed a promising new line of business.

Quite clearly affairs were in a turmoil, resulting mainly from the fact that the company had been content to specialize for years on building just one product for one customer. Realizing too late that this was a mistake, its directors tended to go to the other extreme and take on a variety of work beyond the capacity of their development team.



The Napier Sabre II developing 2,180 b.h.p., was used extensively during the Second World War in the Hawker Typhoon and Tempest V and VI. The Sabre V illustrated developed 2,310 b.h.p.

Profits had remained high up to the late '20s, thanks to the Lion, which continued to power the aircraft of more than 20 R.A.F. squadrons; but there was little doubt that they would soon begin to fall off disastrously.

In January, 1931, Montague Napier died, and with him passed all vestiges of a family business. H. T. Vane remained as chairman for a year; and then resigned because he could not agree with the other directors that the company should return to car manufacture. For the first time the company looked beyond its own resources for a new chairman, seeking a businessman rather than an engineer; and in May, 1932, Sir Harold Snagge took over the appointment.

Bringing to the job the clear vision and ruthlessness of a banker, he realized that there was no hope of making a trading profit for several years. The main objective must be to cut the losses; and to this end he scrapped all ideas for making motor-cars, sold the "mechanical horse" scheme to Scammell and decided that the future of D. Napier and Son must depend largely on the success of Halford's new range of air-cooled engines. The first of these, a 337-h.p. 16-cylinder engine known simply as the Napier-Halford "H" (because of its unique lay-out with four banks of cylinders in vertical pairs, driving two crankshafts) had put in a brief appearance in 1929 as the power-plant of the Gloster-built D.H.77 monoplane interceptor (J9771). Both engine and airframe were ahead of their day for various reasons; and it was left to the "odd man out," the little 150-170-h.p. six-cylinder in-line air-cooled engine for lightplanes—with the gilt-edged securities—to tide Napier over its worst years.

Known first as the E.97 and later named Javelin, this engine never showed any signs of being a great powerplant, but earned enough orders to keep a modest assembly line going. Besides powering production versions of the Percival Gull and Spartan Arrow, it was fitted in the Mew Gull prototype (G-ACND) in 1933, the simplified-construction Martin-Baker MB-1 lightplane (G-ADCS) of 1935, and the Australian twin-engined Wackett Codock five-seat taxi-plane.

Meanwhile the Napier-Halford "H," under its production name of Rapier, and the larger 24-cylinder Dagger, were being groomed for the main task of putting the company back on its feet. They were good engines, providing eventually a range of powers from 305 h.p. to 1,000 h.p., and they could not have come at a better time. Hitler had just taken the wraps off the new Luftwaffe and Britain was committed to a vast R.A.F. expansion programme.

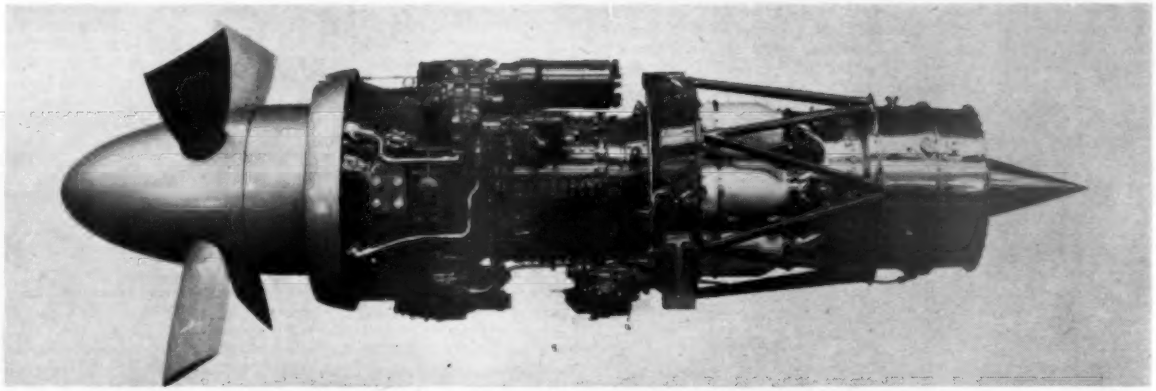
The Rapier had already been tested in a Bristol 124 Bulldog Trainer (K3183), including a period in the full-scale wind-tunnel at Farnborough. The 395-h.p. Rapier VI version was now ordered into production to power the Fairey Seafox seaplane, one of which was to earn fame in the "Graf Spee" action in 1939.

A 450-h.p. Rapier powered the one and only Airspeed A.S.5c Courier (G-ACNZ) belonging to Air Vice-Marshal Sir A. E. Borton, of Napier. Two Rapier VIs went into Blackburn's promising H.S.T.10 10-seat high-speed transport which had a Duncanson hollow-spar wing and retractable undercarriage. With a top speed of 200 m.p.h., it might have done great things had not Blackburn's military work held up development long enough for the outbreak of war to kill it.

One Rapier-engined civil type that did manage to achieve some remarkable flights in the last year or two of peace was the Mercury (G-ADHJ), upper component of the Short-Mayo Composite Aircraft to which Napier contributed £7,000. Powered by four 395-h.p. Rapier VIs, the Mercury became, in July, 1938, the first aeroplane to carry a commercial payload (1,000 lb. of mail) across the Atlantic, setting up a record time for the east-west trip. Three months later, piloted as before by Don Bennett, it set up a distance record for seaplanes of 5,998 miles, by flying from Dundee to the Orange River, which still stands after 20 years.

Unlike the Rapier, the Dagger powered only military types.

Above, the Blackburn Firebrand II (Napier Sabre); above right, the Tempest I; below, the Handley Page Hereford, which was a Hampden fitted with Daggers, and right, the Mercury, upper component of the Short-Mayo Composite Aircraft, which had four Rapiers.



Napier's Eland N.El.1 low-weight single-spool turboprop engine develops 3,000 e.h.p. It employs the Napier single lever control system which provides high standards of safety and flexibility.

Trials of a 705-h.p. version in a converted Hawker Hart (K2434) in 1934 led to a large production contract for the 805-h.p. Dagger III MS to power the Hector Army co-operation biplane. Later, Fairey Battle K9240 became a flying test bed for the 1,000-h.p. Dagger VIII, two of which powered the Short-built Handley Page Hereford.

The only other installation of the Dagger was in the Martin-Baker MB-2 "utility" eight-gun fighter of 1939, which had a top speed of 350 m.p.h. despite the drag of a fixed undercarriage. Designed for rapid production, it reflected to the full the advantages of the powerful lightweight Halford engines, and the Air Ministry's refusal to place a production order was one of the greatest disappointments ever experienced by Martin-Baker and Napier.

But the company had by that time another even more exciting project up its sleeve. Just as it had pioneered the 1,000-h.p. aero-engine in 1919, its directors had decided in 1935 to develop an "H" engine giving twice this power, feeling that it was no longer beyond the capabilities of designers like Sydney Camm of Hawkers to build fighter aircraft able to absorb such a tremendous output.

Halford, by then a Napier director, decided that the new engine should have sleeve-valves. Before the end of the year he had a single cylinder pounding itself to death on the test bench. Satisfied with the basic design he progressed to two-cylinder and six-cylinder test-units and finally, in November, 1937, to a complete 24-cylinder prototype of what became the Sabre. In the following month the Air Ministry ordered six Sabres: in May, 1939, 100—and it was soon apparent that they wanted all the engines that Napier could build. To meet this inevitable demand the company opened a bench-test installation at Park Royal and a flight-test centre at Northolt.

Long before the Air Ministry had ordered the Sabre into full production, Napier, with the financial support of Lord Nuffield, had decided to prove the capabilities of the new engine by building round it a tiny wooden racing aeroplane for an attack on the World's air speed record. Built by the Heston company, the prototype was, unfortunately, not ready for flight testing until June 12, 1940. By then the War had removed all possibility of breaking records with the highly secret engine, which had meanwhile completed its initial test flights in a Battle (L5286).

The first prototype of the Napier-Heston racer (G-AFOK) crashed on landing at the end of its maiden flight; the second (G-AFOL) was abandoned although two-thirds complete.

There was, in any case, no longer much need to convince anyone of the Sabre's possibilities. Camm had designed a mighty single-seat fighter named the Typhoon around Halford's powerplant, which gave 2,200 h.p. for a weight of only 2,360 lb. The prototype of the new fighter flew on February 24, 1940, and eventually the Typhoon was put into full production by Gloster.

There was no time to develop either airframe or engine with the usual care, and the R.A.F. paid for its new fighter at high cost in casualties and unserviceability when it entered service in September, 1941. To repeated engine failures were added structural failures caused by the new phenomenon of compressibility as airflow over the wings approached supersonic speed in a dive. But the Typhoon's troubles were mastered and it became the first fighter to counter the Focke-Wulf Fw 190, before blasting a way through Normandy for our armies in 1944 with the dreadful power of its newly added rockets.

With the thin-wing Tempest, originally the Typhoon II, Sydney Camm's airframe and Halford's engine realized their full potentialities, giving the R.A.F. a fighter with a high-enough cruising speed to deal with the V.1 flying bomb at just the moment when it was most needed.

Perhaps the best tribute that can be paid to the Sabre is that it was ordered in such vast numbers that the company had no time during the War to turn its mind to the new power of jet-propulsion, even if the Government had been prepared to let it divert part of its development resources to this purpose.

That the consequence of this late start in gas-turbine development was not more serious is due in no small measure to events that occurred in 1942. As in an earlier war, the Government took a hand in the company's affairs and asked Sir George Nelson, of English Electric, to reorganize the Acton works for mass-production of the Sabre.

It took little time to convince the Napier board that far more than a temporary reorganization was needed to enable their company to survive its far-too-rapid entry into the world of mass-production of which it had no experience. Financial skill was not enough to meet the challenge of new techniques and the frightening complex demands of the gas-turbine age that must follow the death of the Sabre. They were grateful when Sir George Nelson proposed that his English Electric Group should take over their company, and nothing that has happened since can have brought any regret at the final loss of independence in an industry where amalgamation and "rationalization" are often the prerequisites to substantial contracts.

Faced with the choice of two paths in post-War gas-turbine development, Napier chose the turboprop, adding later its own ideas on free-turbine design. Success did not come quickly and easily. The little 1,500-h.p. Naiad turboprop found no application, neither did the Nomad compound engine with its promise of fantastic economy and range resulting from the combination of Diesel and turbine techniques, or the Oryx gas-producer which was abandoned by the Government with the almost-complete Percival P.74 helicopter for which it had been specifically designed.

But today the future looks full of hope, for Napier has large contracts for the Gazelle free-turbine engine to power the Westland Wessex and Bristol 192 helicopters, plus initial contracts for the Eland, both for the Canadair 540 and for its own Convair conversion scheme. It has the Gazelle Junior under development, and special versions of the Eland in the immensely promising Fairey Rotodyne airliner and Westland Westminster helicopter.

In addition there are large contracts for turbo-blowers, castings and the Spraymat electrical-surface heating system. But, as in the past, right from the day when Montague Napier built his first 8-h.p. engine, perhaps even from the day when the Nay-Peer press turned out fine printing by manpower, the company's main pre-occupation is with power in many diverse forms.

With performance potential greater even than the turbines are the new ramjets, and the Double Scorpion rocket that will one day boost the P.1 fighter built by Napier's sister-company to around 1,500 m.p.h. The company's Deltic Diesels are finding growing application in locomotives, ships and industry. With English Electric already engaged in the further greater revolution of our age—nuclear power—it may not be too hazardous to guess that one day Napier might follow the Deltic with a far-more-advanced form of engine that will give locomotives, ships and aircraft a performance and efficiency beyond the wildest dreams of even those three remarkably inventive men who gave the company its name.

Part 2 of H. J. Heinrich's paper . . . .

Planning and Control in Air Transport

(*Continued from page 757, last week*)

Scope of Production Planning and Control

The totality concept in Planning and Control requires the design of a programme which will take care of the complete cycle in the production process from forecasting the business activity to delivery of the finished product.

It is important to the success of the programme that its various parts be arranged in logical sequence and interrelated with one another to give continuity in production flow.

The following seven areas are recognized as the principal features of a well-rounded Production Planning and Control programme: (1) Production Forecasting; (2) Production Processing; (3) Material Supply and Control; (4) Production Scheduling and Control; (5) Production Analysis; (6) Budgeting and Cost Control; (7) Organization and Personnel.

1. **Production Forecasting.** The first step in planning the operation of a production department is to ascertain in detail the volume of work it will be called upon to do. In an airline, the work of the Maintenance and Overhaul department stems from a combination of two sources:—

(a) The Operating Plan covering the projected flying hours to be performed by the various fleets of aircraft on specified routes.

(b) The Technical Plan covering the elapsed hours when aircraft and their units must be brought in for a specified amount of maintenance and overhaul.

When it has been decided "what" and "how much" work must be done then a Production Plan is arranged to spell out "where" and "when" the work load will be carried out.

The Production Forecast, thus, is the optimum arrangement of work load to provide serviceable aircraft for scheduled airline operations.

2. **Production Processing.** Whilst the forecast establishes the volume and arrangement of production it is the purpose of the processing activity to determine the characteristics of each production item in order to allow realistic scheduling in hangars and shops.

To prepare the work load for scheduling the following activities need to be performed:

(a) Individual jobs are studied to decide on the best method of doing the work, breaking it down into individual production steps and sequencing them so as to minimize time and expenditure.

(b) Based on an intimate knowledge of the job, a standard is set up for manhours, material requirements and elapsed time.

(c) The ground facilities required to do the job are specified in terms of machines, building space and services.

(d) The various jobs are arranged into a total work load programme with a view to minimizing physical interference with one another.

(e) The entire processing activity is laid down in a manual of job process instructions.

(f) A system is designed to measure standards, utilization, elapsed time, etc., to permit evaluation of work performance.

3. **Material Supply and Control.** Before a job can be considered ready for scheduling, the process information must be accompanied by the required materials. To ensure maximum availability of material and minimum investment in inventory, it is necessary to design a Material Planning programme which comprises the following steps:

(a) Based on the Production Forecast and Material Standard for each job total requirements for a specified period of time are estimated. This includes spares coverage for the plant, outstations and pipe-line.

(b) Material is provisioned (i.e., ordered and supplied) against a definite timetable.

(c) Material is requisitioned from the Stores area as called for by the Production Schedule.

(d) Material is packaged and shipped to outstations from Stores areas to maintain necessary local inventories.

(e) Material is transported within the plant between hangars and shops to maintain production flow sequence and schedule.

(f) Material usage is monitored against standard and planned supply cycle.

(g) Material cost is monitored relative to inventory investment, price fluctuations, etc.

4. **Production Scheduling and Control.** When all processing has been completed and material obtained, a job is ready for scheduling in shops and hangars. Since all jobs are interrelated, as they tap a common pool of manpower and facilities, they must be arranged in a package which will best fit the forecasted programme (e.g., aircraft check) within its limits of time and resources. Such an arrangement is called a Production Schedule. The activity which monitors actual work against the schedule is referred to as Production Control.

More specifically a sound system of Production Scheduling and Control will take the following steps:

Scheduling

(a) Recheck on Production Forecast and adjustment in line with current conditions.

(b) Arrangement of processed jobs into a suitable timetable covering a specified period.

(c) Maximum prerequisitioning of materials for known work supplemented by on-the-spot requisitions for unpredictable work.

(d) Positioning of materials at work location.

(e) Arrangement for adequate manpower (numbers and skills) in accordance with the timetable.

(f) Arrangement for adequate equipment, space and services to carry out production.

(g) Layout of Production Schedule showing every job assigned to a specific man against the timetable.

(h) Display of Production Schedule at work location.

Control

(a) Control of production programmes by means of periodic check against Production Schedule.

(b) Control of total paid time for labour by means of attendance or gate card system.

(c) Control of job time for labour by means of a job ticket system.

(d) Control of material expenditure by authorization of requisitions.

5. **Production Analysis.**—When actual production has been completed it is necessary to analyse performance so that adverse trends and conditions can be quickly remedied.

During the Production Control phase on-the-spot progress checks are carried out for the purpose of adhering to the schedule. The analysis which follows completion of the work enables management to view the total picture and concentrate on those deviations which are significant to the whole.

Various facets require analysis including reasons of deviation:—

(a) Volume of production actually turned out against that scheduled.

(b) Elapsed time of a job and programme against that allowed in the schedule.

(c) Manhours of a job against standard.

(d) Labour cost (straight and overtime) of a job and programme against standard.

(e) Material consumption and cost for a job against standard.

(f) Manpower and plant utilization against schedule.

6. **Budgeting and Cost Control.**—The quality of a production schedule must be evaluated from two points of view: (a) How effectively does it meet operational requirements; (b) What is its cost?

A budget, as applied to production, represents the price tag on the schedule. When considering the entire Maintenance and Overhaul department the production budget must be extended to cover all other items of a non-productive nature.

Just as the Production Budget is the financial counterpart of the Production Schedule so Cost Control is the money equivalent of Production Control. Whilst Production Control monitors performance against the Production Schedule, Cost Control watches expenditures against budget allocations.

A sound budget and cost control programme for the Maintenance and Overhaul department in an airline should cover areas and be based on principles as given below:—

(a) A Capital Budget to provide funds for the acquisition of and major changes to property and equipment (i.e., machine tools, etc.).

(b) An Operating Budget to provide funds for the day-to-day expenses required to accomplish the work load.

(c) Budget allocations to be provided in three forms: Against Organizations (e.g., shop, hangar, base, department); Against Programmes (e.g., specific fleets of aircraft

and routes); Against Resources (e.g., labour, materials).

(d) Expenditure reports to parallel equivalent budgets in every respect for comparison purposes.

(e) A speedy and standardized system of budgeting and expense reporting.

(f) Financial Analysis by personnel who are technically well informed and qualified in economics.

(g) An effective system of overhead allocation.

(h) A system of interdepartmental cross-charging, i.e., payment for services rendered.

(i) A system of proportional expense allocation over the life span of the equipment.

(j) A system of production costing (e.g., cost per Generator overhaul) in addition to operational costing (cost per flying hour).

(k) The principle of equating expense responsibility with real authority and control.

(l) Suitable procedures and techniques to formalize all budget and cost control functions. This will specifically include a coding system, responsibility charts, etc.

7. **Planning Organization and Personnel.**—The effectiveness of a Production Planning and Control programme depends ultimately on the people who design and administer it. How these men are aligned organizationally will affect their performance and happiness. Some relevant tenets are:—

(a) Planning should be independent of Production and on an organizational par with it.

(b) The Planning organization should parallel as closely as possible the Production organization to facilitate relationships and administration of a complete work programme.

(c) The organization can be along product lines (e.g., type aircraft) or functional lines (e.g., processing scheduling).

(d) Planning must have the following responsibilities together with the necessary authority: Development and administration of entire Planning programme, including Planning methods, procedures and facilities; Development and formalization of Production Schedule; Progress checking and rescheduling during production; Performance analysis after production is completed and recommendations to production managers.

(e) Job Descriptions and interrelationships within Planning and with other departments must be clearly spelled out.

(f) The group of planners should contain a cross-section of all trades in the production department.

(g) The planning department should be well endowed with administrative talent.

(h) An induction training programme for planners should include Production Planning and Costing; human relations and familiarization with functions of related departments.

(i) Follow-up training especially for supervisory levels should include Business Administration, Industrial Engineering, Accounting, Operations Research and Executive Development.

(j) Understudy and rotational programmes within the Planning Department and with the production department should be encouraged and formalized.

Climate for Orderly Development

The introduction and continued development of a Production Planning and Control programme will be greatly facilitated if the climate in the company is one that encourages innovation, orderly thinking, teamwork, broadmindedness and fact-finding. Conversely, such a company discourages seat-of-the-pants management as well as loose organization and administration.

More specifically, a favourable climate should include:—

1. Profit consciousness throughout entire company, sparked by incentives for cost reduction which results in some form of profit sharing.

2. Schedule consciousness furthered by factual knowledge of the effect deviations from schedule have on company profit and reputation.

3. Managerial leadership giving clear objectives and follow-up on performance.

4. Well defined organization, responsibility, authority and job interrelationship to create team spirit, avoid confusion and duplication of effort.

Planning in the Company Hierarchy

Planning is an activity which is performed for almost every function in the company. An airline usually establishes Planning as a distinct activity in Sales (Market Forecast), Operations (Flight Legs and frequencies), Maintenance and Overhaul (Production), Company level (new aircraft, new routes, financing, etc.).

It is important to recognize that all planning throughout the company is interrelated and requires to be properly interconnected. Whilst individual planning sections may belong to different departments, their efforts should be guided by a common policy and objective. Communication between them needs to be complete and continuous to ensure that each department's plan is in tune with the complete company programme.

The Planning department should always report organizationally to the boss man of all activities which it is required to plan. Its status in the hierarchy should not be less than that of the principal "doing" department. Such an arrangement will enhance teamwork.

Theory and Common Sense

It is one thing to design a Planning system and another to operate it. The designers should be free to theorize and not be afraid of idealism. However, when the theoretical model has been constructed it should be subjected to exhaustive practical testing to ascertain the physical and human limitations likely to be imposed upon it during its operational life. Once company activities have been evaluated for their significance to the business as a whole, it is usually possible to arrive at a compromise which will marry the theoretical principles to the practical environment.

Under normal circumstances it will be foolhardy to attempt transposing the planning system of one company onto another. Today there are as many systems as there are companies using them. Whilst they all have much in common each is adapted to best fit the philosophy and operational requirements of its management.

To avoid painful and costly mistakes a Planning system should be introduced gradually and against a Master Scheme. Extensive proving should take place to establish its worth and give management a preview of potential benefits.

Reasonable and Unreasonable Expectations

If a Planning system is introduced to correct an unsatisfactory situation, there will be a natural tendency for management to be impatient for results and consequently exert great pressure to bring them about. Concurrently the planning people will try to make a showing and prove their predictions in record time. This eagerness on both sides is healthy, but caution should be exercised that the strong desire for quick returns will not compromise the principles of the programme and jeopardize its ultimate success.

The master plan against which the programme is introduced should be accompanied by improvement estimates based on a definite timetable.

Betterments should be planned for such items as labour productivity and utilization; material consumption and usage; equipment and facilities utilization, size of overhead; operating and financial performance, etc.

Predictions should be conservative; they need to indicate the ups and downs so that expectations will be reasonable. Nothing will harm a Planning programme more than extravagant claims for the future which are not realized.

Speculation for the Future

Production Planning and Control in the air transportation industry today is in a state of heavy development. Looking ahead to the jet era it may be opportune to speculate on the direction the profession will take to meet the exacting requirements of aircraft each costing more than $5,000,000 and flying in excess of 500 m.p.h.

The future airline will be subjected to financial and operational pressures which will tax its ingenuity for optimizing performance to a degree hitherto considered unattainable.

Production Planning and Control may well hold the key to the profitability and survival of an airline in the years to come. The type and quality of the programme are therefore of paramount importance to management.

Areas of future endeavour may include:—

1. More scientific market research resulting in firmer operating schedules. Production forecasts will then require fewer changes causing plant operation to be more stable and economical.

2. Increased knowledge and predictability of work load.

3. Increased standardization of work programmes as to job content.

4. Improved job methods and standards.

5. More efficient machines and working space.

6. Better knowledge of materials and component behaviour resulting in greater ability to predict material requirements and higher economy of usage.

7. Greater utilization of manpower and machines.

8. Increased automation of planning, control and analysis resulting in faster and more factual information for management to take action.

9. Greater specialization of the worker beyond his present trade category.

10. Increased mechanization of supporting functions, e.g., material delivery to work location.

11. Streamlining of paper work (e.g., elimination of material requisitions).

12. More informed selection and training of Planning staff.

13. More meaningful industry standardization of technical and economic evaluations; job and account definition; production and financial reporting.

PRIVATE FLYING

H.J.C.'s Club Commentary:

● ONE OF the events which suffered from the weather over the Whitsun holiday was the tea patrol organized by the **Cheltenham Aero Club** on May 24. A Tiger Moth from the Armstrong Whitworth Flying Club at Coventry arrived, carrying Mr. M. J. Rose and Miss Carole Ellis, and later two Autocrats came in from Leicester East, though they were too late to qualify. Among the visitors was the Mayor of Gloucester, Cllr. V. T. G. Bennett and Mrs. Bennett, the former being taken for his first flight by Flt. Lt. L. A. Titmuss.

Although this patrol was not successful, another is to be arranged soon, when it is hoped that the weather will co-operate.

● STAVERTON AERODROME is now managed by Smiths Aircraft Instruments, Ltd., instead of Cambrian Airways. The managers are responsible only during week-day working hours, and the club has to see that enough people are available for the proper running of the aerodrome at other times, and is responsible for maintenance of ground and flying discipline in the evenings and at week-ends.

The holding company, Club Aviation (Cheltenham), Ltd., is becoming separated from the Cheltenham club. Formerly it maintained aircraft of both the Cheltenham club and of the **Cotswold Aero Club**, who will still have the benefit of whatever saving in costs that can be effected. But there is no immediate hope that flying rates can be reduced.

The Cheltenham club is operating a Messenger and an Autocrat (G-AHAM).

● AT THE annual general meeting of the **Kuala Lumpur Flying Club** the following officers were elected:—

President, R. L. Akers; vice-president, V. Arunasalam; club captain, Sqn. Ldr. A. E. Nichol; vice-captain, J. B. Molloy; committee members, H. E. Talalla, Yoong Siew Fun and A. K. Robinson. The honorary treasurer is H. C. Roberts.

The club operates two Tiger Moths, VR-RBD and VR-RCD, and an Auster, VR-RBM; a Chipmunk is to be acquired.

In 1957 16 S.P.L.s were issued; eight members made their first solos and nine P.P.L.s were gained.

● ABOUT £4,700 from war funds of 17 years ago has been shared among the Federation of Malaya's four flying clubs, those of Penang, Kuala Lumpur, Perak and Kluang.

A committee appointed under a war funds disposal order recently decided to issue the money to the clubs as it was originally given for air defence purposes, and will now help more young Malayans to learn to fly. The greater part of the money is from the Penang Spitfire Fund and the Perak Patriotic Fund.

FOR RELAXATION.—Capt. Carl Thompson, of Eastern Air Lines, has built this 16-ft. span Mighty Mite 6C partly from the last of the three Goodyear-type racers he designed. It has an 85-h.p. Continental engine and cruises at 150 m.p.h. It has an all-metal wing, with plywood wingtip plates which provide exceptional stability at low speed.

Per Ardua Ad Australia

Pressure of events has made it necessary for the second instalment of Mr. David Hill's account of flying to Australia in a Percival Prentice (D.H. Gipsy Six engine) to be held over. The story will be resumed next week.

GLIDING NOTES

AS noted in "Matters of Moment," the R.A.F. Gliding Championships were held at South Cerney from May 17 until May 27. Saturday and Sunday, May 17 and 18, were unflyable, and on Monday, when the task was distance along a line through Swanton Morley, in Norfolk, everyone was so blown off course by a strong cross-wind that nobody's "projected" distance along the line reached the minimum needed to score.

On Tuesday, May 20, both classes were given a goal race, the unstrutted sailplanes to Hawkinge and the strutted gliders to Lasham. As the pilots were chasing a retreating front, many had to hold their speed in check to avoid catching up with it. Neither goal was reached, but Sgt. Gough, with 133 miles in the Wessex Club's Skylark 3, and Wg. Cdr. N. W. "Paddy" Kearon, with 131 miles in the same club's Olympia, landed between Ashford and Hawkinge, and Flt. Lt. Roger Mann, of the Moonrakers' Club at Upavon, landed its Gull 4 at Tonbridge.

Wednesday, May 21, was cross-Channel day, the official task for both classes being free distance "north or south of the London Control Zone," with disqualification for anyone entering the Zone. Even the Channel coast was not easy to reach, and Roger Mann, who made second-best distance, was brought down through getting too far south of track over the Romney Marshes after a 2¼-hour flight. The Gull I in which Geoffrey Stephenson crossed the Channel in 1939, and which is now owned by the Fenland Club of R.A.F. Marham, seemed disinclined to do it again, for Flt. Lt. G. Rondel took it north of the London Zone to Great Dunmow.

* * *

Local variations of cloud height and type on this day, together with their probable explanations, were noted by Flg. Off. F. R. Padgham and Flt. Lt. F. W. Allen, who took the Wessex Club's Sedbergh on the longest flight yet made on that type, it is believed—96 miles to Tonbridge. They started off with the help of a localized cold front extending from South Cerney to Swindon. There was good lift outside its front edge at 4,500 ft., and rain poured out of a 1,000-ft. cloud base at the back.

They had to stay near it while it was active, because if they went too far ahead of it there was no lift to be found. Later, cloud base rose to well above 6,000 ft. in air which had been dehydrated by the Welsh mountains, but later still they were in air which had come up the Bristol Channel and cloud base descended again to 4,500 ft. But in trying to follow it down at 70 knots they found themselves still going up at 10 ft./sec.—which shows the sort of lift that was around that day.

As to Andy Gough's trip to Holland (for details see under "Matters of Moment"), I looked in on the following afternoon in the hope of finding him back, but instead found Air Commodore G. J. C. Paul, who was in charge of the Championships, hard at work beside the telephone trying to arrange return transport for both Gough and his Skylark. It was eventually packed into a Valetta which happened to be on a routine flight to R.A.F. Benson, in Oxfordshire, where the trailer met it.

The next good day was Friday, May 23, with some powerful cu-nims around, though rather scattered. Roger Mann took the Moonrakers' Gull 4 into three of them in succession, getting 10,000, 13,000 and finally 14,500 ft. of height and 1¼ in. of rime ice on the leading edge, strips of ice projecting from the trailing edge, and ice on the aileron horns and brakes. He landed at R.A.F. Hemsworth, in Lincolnshire.

Flt. Lt. Ken Fitzroy nominated Ouston, Yorks, as a 300-km. goal, but fell short by a few miles, making 179 miles to Dishforth in an Olympia in 3 hr. 35 min., which was fast going. Flt. Lt. Clark and Sqn. Ldr. Croshaw reached 10,500 ft. on the way to Pickering in the Cleveland Club's Kranich. But this was not a contest day, and the wind was too strong for Grunaus and suchlike to be allowed out.

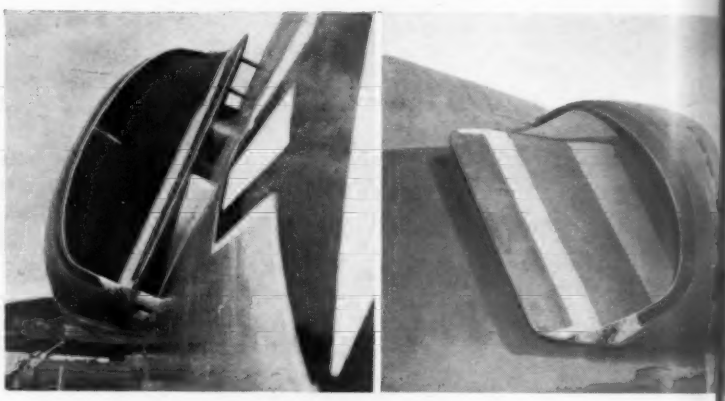
Whit-Sunday's task was a race to Marham, only completed with much difficulty by Andy Gough, and on Whit-Monday a 52-mile triangle via Little Rissington and Aston Down proved impossible, though "Paddy" Kearon nearly managed it.—A. E. SLATER.

DELTA DART DETAILS

Howard Levy photographs

Above, Convair's F-106A Delta Dart interceptor powered by a Pratt & Whitney J75 turbojet with reheat differs from the F-102 Delta Dagger in having a "clipped" vertical tail instead of a pointed one, and a twin-wheel, instead of a single, nosewheel unit.

Above, details of the Delta Dart's airbrake and reheat tailpipe orifice are highlighted in this view.



Above, variable-area fuselage-side intakes are employed for the J75 turbojet; in these the inside wall is hinged and can open out or close up the intake area automatically, according to the speed and altitude conditions.

Above, this close-up of the wing of the F-106A shows the extent of the conical camber that has been employed on the leading-edge. Note, too, the very thin wing section used.

Left, although the Delta Dart's wing has a very small t/c ratio, its absolute thickness at the root gives plenty of room for undercarriage stowage; the main wheel, it will be noted, is a comparatively wide one.

The French Approach to STOL

VERTICAL take-off and landing can readily be achieved for a substantial penalty in payload and operating efficiency, but the Breguet company in France is now setting out to show that by accepting a very short take-off and landing run, the maximum weight which may be lifted vertically for a given power can be doubled or trebled. In the new Breguet Br.940, which made its first flight on May 21, STOL is achieved by bathing the entire wing in the slipstream from four large airscrews, in conjunction with deflected thrust by means of large-area camber-changing and slotted flaps.

This arrangement avoids the extreme mechanical complications of tilting rotor/airscrews or pivoting wings for obtaining vertical lift, and also the alternative penalty in aircraft achieving STOL by very low wing-loadings and conventional high-lift devices, of a low cruising speed and high structure weight. The idea of maintaining high C_L values at very low speeds by means of airscrew slipstream is by no means new, and attempts to achieve this with the wartime Airspeed and General Aircraft "Fleet Shadowers" may be recalled, but deflecting the thrust almost vertically downwards by a system of flaps is a new and additional factor which enables zero-speed performance to be achieved if required.

One of the biggest advantages of this arrangement, which cannot be realized with pivoting wings or similar potential solutions to VTOL or STOL problems, is the benefit of substantial translational lift from forward movement. With the very high

These two photographs, which are copyright THE AEROPLANE, show the camber-changing and slotted flaps, and aileron segments of the Breguet 940 Intégral in the neutral or cruising position. In the heading photograph, they are shown fully deflected to almost 90 degrees.

thrust of the airscrews at take-off power, acceleration is rapid, and the airscrew wash, deflected downwards, is soon augmented by the velocity of the slipstream. With this additional translational lift the aircraft takes off after a very short run, and climbs away at an extremely steep angle. Efficiency of the slipstream deflected to about 60° is said to be something like 99% that of a rotor or airscrew pivoting through 90°, but in cruising flight, with the flaps retracted, the aircraft becomes conventional, with a large power reserve and a relatively small wing.

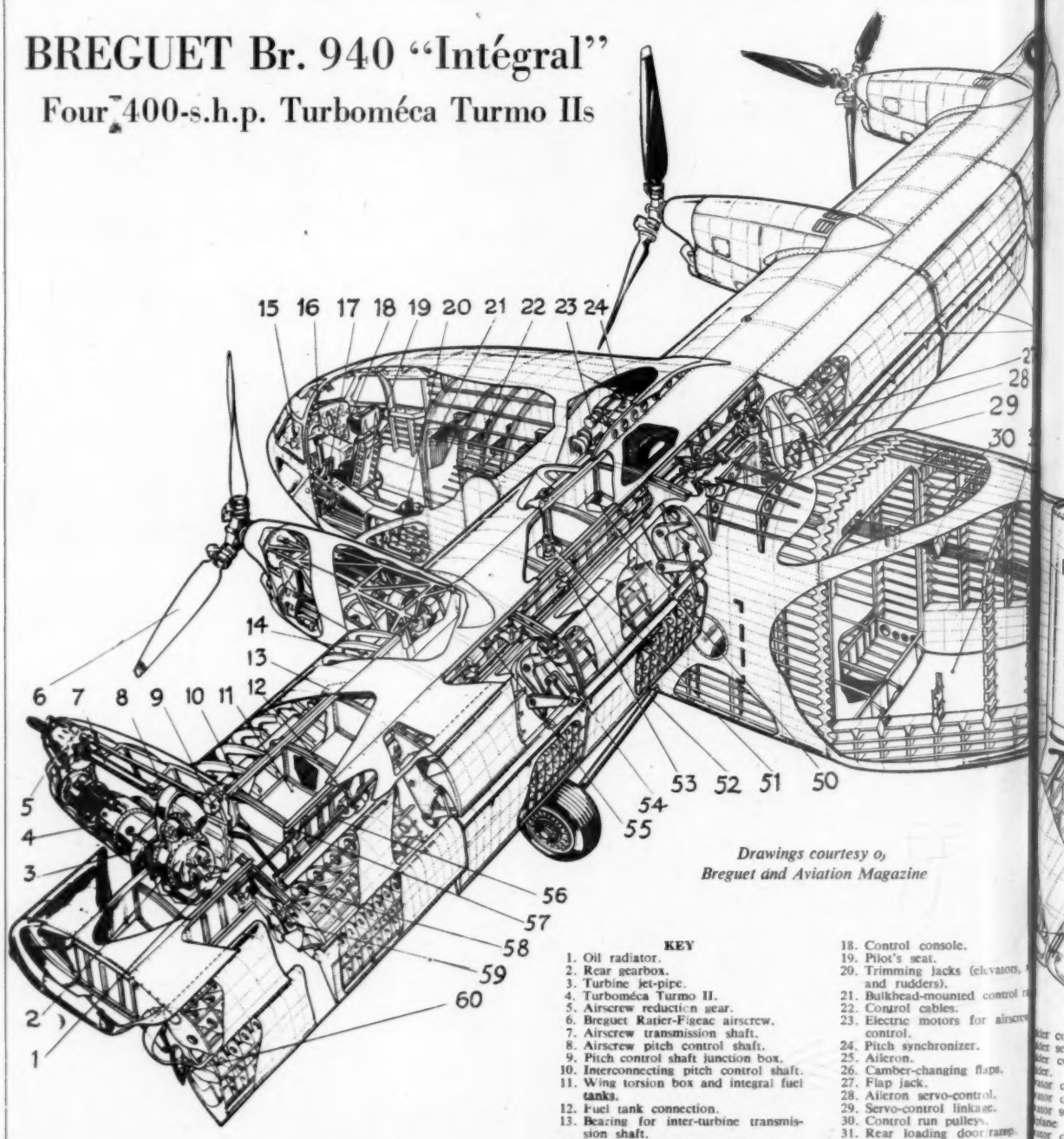
For particular VTOL requirements, zero-speed flight can be achieved at a fuselage angle of 25°, plus 5° incidence and by restricting the gross weight. But because of translational lift, the latter may be doubled for a take-off run of 50 yd. or trebled for an increase to about 200 yd.

To prove these theories Breguet began calculations and wind-tunnel tests more than 10 years ago, and these progressed to the point where it became possible to begin building an experimental prototype, the Br. 940 Intégral. This, in effect, is a flying-scale model of the much larger Breguet 941 transport project, which is being designed for either high-density inter-city passenger transport or military assault cargo missions, the advantages of STOL being most apparent over short hauls.

One of the biggest problems in the Breguet STOL arrangement is to synchronize the speed and thrust of all four airscrews to prevent variations in lift, and also to guard against engine failure, which could cause unmanageable asymmetric lift. The solution is provided by the use of free-turbine turboprops, which in the Breguet 940, are 400-s.h.p. Turboméca Turmo II

BREGUET Br. 940 "Intégral"

Four 400-s.h.p. Turboméca Turmo IIs



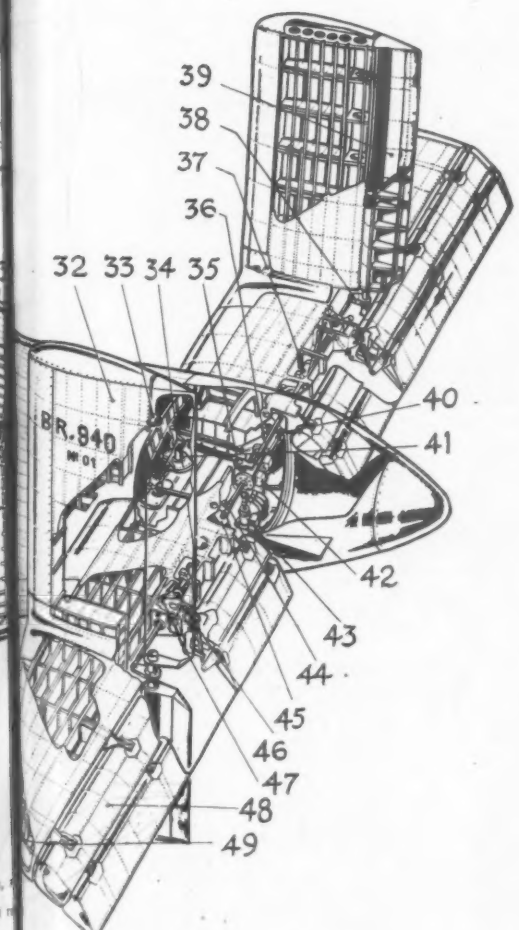
Drawings courtesy of Breguet and Aviation Magazine

KEY

1. Oil radiator.
2. Rear gearbox.
3. Turbine jet-pipe.
4. Turboméca Turmo II.
5. Airscrew reduction gear.
6. Breguet Ratier-Figeac airscrew.
7. Airscrew transmission shaft.
8. Airscrew pitch control shaft.
9. Pitch control shaft junction box.
10. Interconnecting pitch control shaft.
11. Wing torsion box and integral fuel tanks.
12. Fuel tank connection.
13. Bearing for inter-turbine transmission shaft.
14. Turbine transmission shaft.
15. Instrument panel.
16. Control column.
17. Throttles.
18. Control console.
19. Pilot's seat.
20. Trimming jacks (elevators, and rudders).
21. Bulkhead-mounted control
22. Control cables.
23. Electric motors for airscrew control.
24. Pitch synchronizer.
25. Aileron.
26. Camber-changing flaps.
27. Flap jack.
28. Aileron servo-control.
29. Servo-control linkage.
30. Control run pulleys.
31. Rear loading door ramp.
32. Fin.
33. Rudder hinge.
34. Rudder control quadrant.
35. Rudder bell-crank.

units, linked by shafting to each other and to the airscrews. At the rear of each turbine unit is a main gearbox, which reduces the 24,000 maximum r.p.m. of the free turbine to a maximum of 3,545 r.p.m. for the interconnecting and airscrew drive shafts, while the forward gearbox in each nacelle gives a final drive for the airscrews of up to 1,027 r.p.m.

In each rear gearbox is a weak link, so that in the event of component failure or seizure the airscrew shaft will be free to be driven by the other power units. The airscrews themselves are three-bladed Breguet Ratier-Figeac units of 12.47-ft. diameter, which are mounted so that each pair intermesh with each other, rotating in opposite directions. The outboard airscrews are arranged to rotate in the reverse direction to the normal wingtip vortices, which they therefore cancel out.



...der control rod.
...der servo-control.
...der control lever.
...der.
...tor control linkage.
...tor control quadrant.
...tor servo-control.
...plane incidence jack.
...tor control rod.
...trol relay.
...rol bell-crank.
...-elevator hinge bracket.
...elevator segment.
49. Tailplane.
50. Wing-fuselage pick-up.
51. Undercarriage oleo-leg attachment point.
52. Undercarriage radius rod.
53. Camber-changing control runs.
54. Flap actuating rod.
55. Flap control rod.
56. Aileron control rod.
57. Control rod bearing.
58. Flap actuating rod.
59. Aileron actuating rod.
60. Aileron mass-balance.

Other major problems with this type of STOL aircraft are those of low-speed control, and of maintaining fairly constant control characteristics over the wide speed range. The control system of the Br. 940 is one of its most interesting features, although it is also one about which the least may be said. After the initial flight tests, lateral control at low speeds will be augmented by the use of differential pitch on the outboard airscrews, by an automatic linkage with the flying controls. Lateral control is perhaps the least difficult to achieve at low speeds because of the fairly constant airscrew wash, but with linked propellers it is obviously necessary to decrease the pitch of the inboard units when increasing that of the outboards and vice versa.

All the control surfaces—ailerons, elevators and rudders—are actuated through SAMM hydraulic servo mechanisms, and hydraulic power is also used for operating the flaps and variable-incidence tailplane. Power controls are almost essential for maintaining a constant, if artificial, feel and response over the speed range, and offer the further capability of being set or adjusted to any desired values. The characteristics of the Br. 940 controls are modelled on those of Breguet's Alizé anti-submarine aircraft, which has manually-operated ailerons and elevator and a servo-assisted rudder, and were initially set up on an analogue computer.

Low-speed longitudinal stability and control were also studied on the computer, as being the most critical cases of the three axes. As a result an auto-stabilizer was developed, mainly for operation in pitch, and the desirability of special controls for the zero-speed case was indicated. These are not being explored in the Br. 940, which is limited by its low power to a minimum speed of 70-80 k.p.h. (43-50 m.p.h.). It is intended, however, to resolve all the control problems almost entirely automatically, so that no particular STOL handling problems will be presented to pilots.

In an arrangement such as is employed by the Breguet 940 the tailplane position is critical for the low-speed case, since a large proportion of the slipstream is deflected almost vertically downwards when the flaps are lowered. As with the wing flaps and ailerons, the elevators are composed of two separate segments separated by slots, but the rudders of the Br. 940 are conventional single surfaces.

Camber-changing Structure

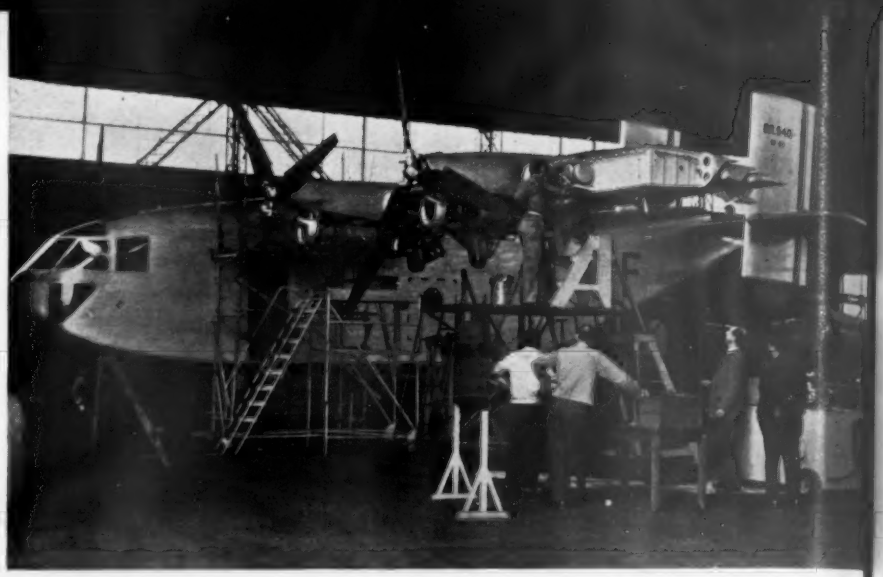
The thick (17% t/c ratio) Breguet L-14 section wing of the Br. 940 is built round a two-spar box, to which is attached the deflector flap system along the entire trailing edge, outboard of the fuselage. The inner half of each semi-span comprises camber-changing flaps occupying nearly 50% of the constant chord, and made up of interdependent central and rear main portions. Each of these has its own slot, and the rear segment carries an additional slat which at maximum camber is exposed to assist the optimum deflection of the slipstream.

Large faired double-hinge brackets are mounted beneath the wings, and the linkage is so arranged that the deflection angle of the rear flap is twice that of the other segment. When the flaps are fully extended the rear portion is not far short of 90° to the wing chord line.

The outer portions of the flap system also each comprise two slotted segments, the rear portions of which function additionally as ailerons. The front portions occupy 21.5% of the wing chord, and the rear segments 26%. Both segments are deflected with the flaps, although the ailerons do not reach quite such acute angles, but their working range then increases slightly. The entire flap system is actuated through a Jacottet-Leduc hydraulic servo unit in the wing centre-section, but the ailerons have their own power control units.

Flaps of such area and angular extension must inevitably result in major trim changes during their operation, and these are catered for by the range of tailplane incidence between +5° and −4°. Although not specified, it is probable that some sort of linkage is employed between flaps and tailplane, so that trim changes are automatically cancelled out. The elevators, with a total width of 35% of the constant tailplane chord, are also in two segments of equal chord, the front portion operating 30° each side of neutral and the rear, through 60° per side, by servo-controls. The powered rudders above and below the tailplane also have a working range of 60°.

The Br. 940 is otherwise entirely conventional in design and construction, with an all-metal stressed-skin structure. It is generally similar in shape to the Breguet 941 design, and has a similar rear loading door-cum-ramp, and nosewheel undercarriage. In the Br. 941, however, the mainwheels will be housed in fuselage blisters, and there will be some improvement in fuselage and wing shape. With exactly twice the gross weight of the Br. 940, the Model 941, at 32,000 lb. (or 40,000 lb. overload for operation from small airfields instead of mere strips) will be powered by four 1,100-s.h.p. turboprop units. Turboméca Turmo IIIs, which were primarily designed for helicopters, and would be very suitable for the Breguet application,



Right, immediately before its first flight on May 21, the prototype Breguet 940 was thoroughly inspected at Villacoublay, after extensive ground trials. Removal of the wing leading-edge and tip has revealed the simple mainplane torsion box.

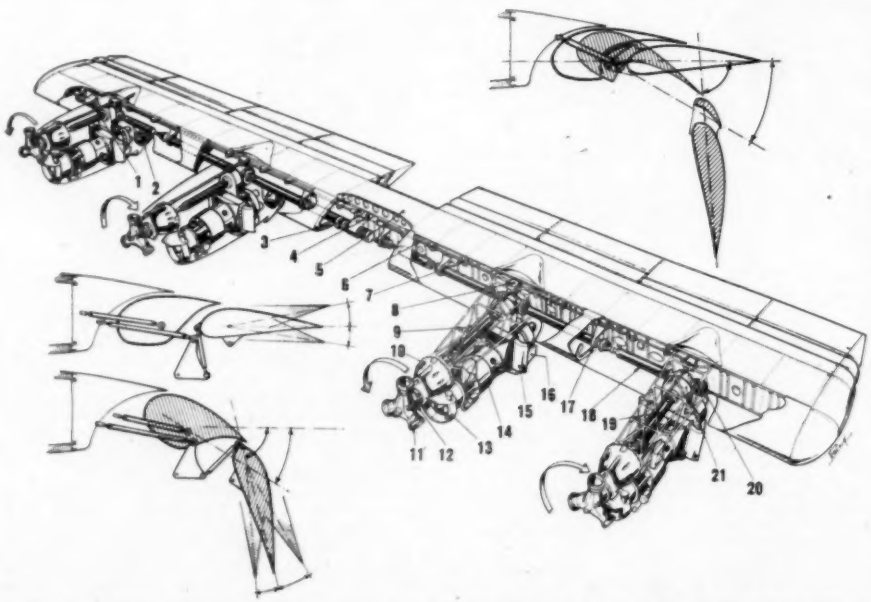
Photographs copyright "The Aeroplane"

Left, this close-up of the Turmo II installation in the Breguet 940 shows the turbine connecting shafts, which are standard truck units, with the smaller pitch linkage rods above them; it should be related to the diagram of the powerplant layout, below.

have been specified for the Br. 941, but this may use any similar turboprop units of roughly comparable power such as the Lycoming T53 or T55 and the General Electric T58 (D.H. Gnome).

At a take-off weight of 16,093 lb., the estimated performance of the Breguet 940 includes a take-off and landing distance, over a 50-ft. obstacle, of less than 650 ft., and a cruising speed at 10,000 ft. of 151 knots (173 m.p.h.). The Breguet 941 is estimated to have a similar take-off and landing performance for STOL operation at a gross weight of 32,500 lb., while for normal small-field operation, the gross weight can be increased to 40,000 lb., increasing the maximum payload from 12,100 to 18,700 lb., or up to 50 passengers, for no-wind take-off and landing distances over 50 ft. of less than 1,500 ft. The 10,000-ft. cruising speed of the Breguet 941 is scheduled as 215-245 knots.—J.E.F.

Comparative dimensions of the Br. 940 and the 941 (in brackets) are: Span, 58.8 ft. (77.5 ft.); length, 49.5 ft. (79.3 ft.); height, 23.3 ft. (23.6 ft.); wing area, 510.2 sq. ft. (898 sq. ft.); freight hold length, 16.11 ft. (30.8 ft.); width, 5.64 ft. (8.13 ft.); height, 6.46 ft. (8.54 ft.); volume, 582.8 cu. ft. (2,110 cu. ft.).



1. Generator. 2. Oil radiator (rear gearbox and turbine). 3. Pitch-change electric motor. 4. Pitch synchronization unit. 5. Wing torsion box. 6. Airscrew pitch transmission rod. 7. Pitch rod bearing. 8. Pitch control junction box. 9. Airscrew pitch control shaft. 10. Airscrew reduction gear (3,545 to 1,027 r.p.m.). 11. Airscrew hub. 12. Pitch change mechanism. 13. Engine oil tank. 14. Turbomeca Turmo II (34,500 max. compressor r.p.m., 24,000 max. free-turbine r.p.m.). 15. Jet-pipe. 16. Rear gearbox oil tank. 17. Turbine transmission shaft bearing. 18. Transmission shafting. 19. Transmission shaft to airscrew reduction gear. 20. Rear gearbox. 21. Hydraulic pump.

Illustrated diagrammatically is the powerplant layout of the Breguet 940, showing the turbine and airscrew pitch linkages, and also a cross-section of the flaps and ailerons (left) and the inboard flaps (right), housed and extended.

CORRESPONDENCE

Cody's First Flight

THE various opinions expressed as to the authenticity of Cody's first flight can be set at rest by the statements of Mr. Vivian Cody in *The Aldershot News* for April 25 last, a copy of which I enclose.*

The photographs taken by Mr. Cody were also questioned, and he replies to the "doubters."

I must now refer your readers to the *Journal of the Royal Aeronautical Society* for September, 1954, in which it is laid

June 8, 1908, is the date on which the late Sir Alliott Verdon-Roe claimed he first left the ground. In this photograph, supplied by Mr. Broomfield, Roe's biplane of the period is being lifted through the railings at Brooklands.

down by no less an authority than Mr. Charles H. Gibbs-Smith, that Cody made the first sustained flight in Great Britain on May 16, 1908.

The paragraph reads as follows:—

> "Here we may say with fervour, that if only Cody had been naturalized in 1908, instead of 1910 (sic) all the bitter nonsense about certain claims to be the first Englishman to fly would have been knocked decisively on the head, for Cody unquestionably made *the first proper powered aeroplane flights in this country—powered, sustained and controlled*—on May 16, 1908, on his 'British Army Aeroplane No. 1. He made five flights on that day over Laffan's Plain' (sic), the longest being 150 ft., at a height of about 10 ft. On October 5 that year, he flew 496 yd. at about 50 to 60 ft. above the ground."

May I add that in consequence of this evidence I consider that the inscription to this effect should be restored to the plaque on the celebrated tree at Farnborough. It would be the act of a great and courteous gentleman to do this and I know Dr. Gardner to merit that description, which would be enhanced by his doing so.

Virginia Water, Surrey. G. A. BROOMFIELD.

[*In this issue of *The Aldershot News* Mr. Vivian Cody is quoted as saying. "'The machine went out and left the ground on May 16. It may only have been inches, but the wheels were clear of the ground.

"'I am not claiming that as an official flight,' Mr. Cody went on, 'but I am claiming that the machine left the ground and flew for at least 15 ft. clear of the ground. I was there, and I have no reason to lie about it. I took all the photographs of the first flight.'"—ED.]

Questions of Relative Motion

TOWARDS the end of the précis of his paper on inertia navigation to the Institute of Navigation on May 16 [summarized in our issue of May 23—ED.] Wg. Cdr. Anderson is reported to have made two statements which I find difficult to follow.

He said that a Great Circle was not the shortest distance between two points on the Earth's surface; and that an inter-continental missile would travel farther towards the east than the west.

The first statement can be accepted. An imaginary observer in the centre of a transparent planet—revolving, like the Earth, at a surface speed of 900 knots at the Equator—would see an aircraft, which was flying on Great Circle headings from the Equator to the North Pole, following a track in space which veered sharply "east" before following a pursuit curve to the Pole.

In the "space" imagined by this observer (who would consider himself to be stationary and is assumed to be ignorant of the Earth's rotation) the aircraft's actual track would certainly not be the shortest one—though the track actually followed in "true space" (if there is such a thing) would be further modified by the motion of the Earth round the Sun, by that of the solar system round the centre of our galaxy and by that of the galaxy itself.

I find it much harder to follow the second statement unless, perhaps, the missile's track was north-east/south-west. Then there might be an effect from the difference between the Earth's surface rotational speed at the point of departure and the point of arrival. Even here it is difficult to accept the reasoning.

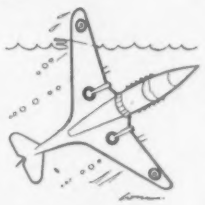
But surely a missile travelling in the plane of the rotation of the Earth must be considered to be travelling over a stationary sphere?

Or have I missed some vital point?

The problem reminds me of the ancient fallacy concerning a magical balloon which could rise up beyond the atmosphere and stay there while the Earth rotated under it. However magical, such a balloon, if released at the Equator, would have 900 knots of initial "speed" and would need to be given braking thrust to reduce this speed to zero before its occupants could enjoy the sight of the Earth rotating quietly below.

London, S.W.3. T.A.H.

Groundabout



The Hunting of the Shark. A shark, it seems, has at least three lives, for No. 112 "Shark" Sqn., first formed in 1917, flew for two years, was re-born in '39, fought right through the War till '46, rose again in '51 and was disbanded last year. During 1941 in North Africa the "shark" face was painted on their Tomahawks and ex-112 pilot Flt. Lt. Robin Brown, now at the R.A.F. Flying College, Manby, is trying to trace whether the idea derived from my "Oddentification" cartoon of the Tomahawk which had appeared in THE AEROPLANE a few months before. At the Squadron's first reunion, organized by Flt. Lt. Brown on May 17 at the famous White Hart, Brasted (near Biggin Hill), Kent, 26 "ex-Sharks" didn't know the answer. But they all reckoned that 112 with its appropriate "motif," was perfectly in line for re-forming as the first G.W. squadron—and to get its fourth life.

*

Rotors Resurgent. We do a bit too much looking back these days, I think, but it was sad to hear of the recent total loss of one of the only two surviving C.30 Autogiros. However, Norman Hill, of Redifon, pioneer rotating-wing pilot (a vertical veteran?), tells me the Science Museum have in their hanger at Byfleet the Gipsy-engined C.24, complete with cabin and nose-wheel undercarriage, which D.H. Tech. School students built in the early 'thirties. If the Museum authorities would relax their grip on it, money and the will to get it airworthy are available.

*

Soar Point. British gliding enthusiasts take a poor view of the *Times of Malta* who seem to take a poor view of British gliding. Evidence, according to B.g.e.s is provided by *T. of M.* headlines. Two years ago, when an R.A.F. Sergeant made a normal "country" landing without damaging himself or sail-plane, they headed their report "Glider Crash." Last month describing a fatal light-aeroplane accident, they included the words ". . . was descending in a glide." Headline: "Glider Pilot's Death Was Accidental."

by Lorenzo

NOTES AND EVENTS

NAPIER EXHIBITION.—As part of the 150th anniversary celebrations of D. Napier and Son, Ltd., an exhibition is being held at the Tea Centre, Regent Street, London, S.W.1. It opened on June 3 and will close on June 14. Exhibits include machinery, cars and engines made by the company since its foundation in 1808.

L.A.P. GUIDE.—Pitkin Pictorials, Ltd., of 9 John St., London, W.C.1, has published a revised edition of the *Complete Guide to London Airport*, by Sir Miles Thomas. It is intended primarily for aircraft spotters and its 32 pp., measuring 7 in. by 9 in., contain more than 110 illustrations of aircraft, buildings, etc. The price is 2s. 6d.

COMET EQUIPMENT.—From Kelvin and Hughes comes a reminder of that company's co-operation with de Havillands on the instrumentation of the Comet 4 (THE AEROPLANE for May 9). Not only did Kelvin and Hughes do a lot of pre-production work on instruments for the aircraft; they are supplying altimeters, rate of climb indicators, Machmeters, Mach switches, accelerometers, engine-speed indicators, cabin altimeters, cabin differential pressure gauges and stall detectors for the Comet 4s being built for B.O.A.C.

U.D.T.'s NEW OFFICES. — On Tuesday, May 20, the United Dominions Trust opened a West End office at 29 Pall Mall, London, S.W.1.

PLANE HIRE.—Reports state that other U.S. car and truck rental agencies are expected to follow the Hertz Corpn. into the aircraft rental business. By the end of this year aircraft hire facilities should be available in 100 cities in the U.S.

A.R.B. APPROVAL. — The Long Meadow Felt Co., Ltd., of Kidderminster, has recently been granted Air Registration Board approval under the Air Navigation Acts. Originally known as Carpet Trades, Ltd., Felt Division, the company has supplied felt to the aircraft industry for a number of years.

ANNUAL DINNER.—Mr. and Mrs. L. A. Rumbold were hosts at L. A. Rumbold and Co., Ltd.'s annual dinner and dance at the Cumberland Hotel in London on May 16. Maj. Jack Stewart proposed the health of the many distinguished guests; Mr. C. T. Wilkins and Mr. P. C. F. Morgan replied.

AUTOSET CASTORS.—A ball-type castor employing an entirely new principle has been devised by Autoset (Production), Ltd., of Birmingham, for the transfer of articles in a conveyor system. The main spherical load-carrying unit is itself carried on an endless track of bearing balls. World patents have been applied for.

FLIGHT INSTRUMENTATION. — Collins Radio Co., of Iowa, has formed a separate Airborne Instrument Manufacturing Department to produce automatic-pilot systems, integrated flight systems, compass systems and other aircraft instruments.

HELICOPTER FACTS.—For those who wish to study in detail the problems associated with providing London with a Heliport, the Helicopter Association of Great Britain has prepared and published a special report under the heading "Examination of the Case for a London Heliport." Copies of this report can be obtained from the Association at 4 The Sanctuary, London, S.W.1. The price is 5s.

PRESIDENTIAL BADGE.—The Society of Licensed Aircraft Engineers has introduced a presidential badge of office, subscribed by some honorary members and by members of the Singapore and Lagos branches. The wreath and clasps are in silver-gilt; the badge and turnbuckle are in silver mounted on a translucent enamelled sky-blue background, and the ribbon is red ochre. The S.L.A.E. president for 1956-58, Capt. E. D. Ayre, A.F.R.Ae.S., M.S.L.A.E., R.A.F.O., was invested with the badge at a recent meeting of the general council.

Aviation Calendar

June 7.—Air Display at **Swansea Airport.**

June 7.—Helicopter Association of Great Britain Garden Party at Dunsborough Park, **Ripley,** Surrey, at 14.30 hrs.

June 7-8.—Fifth International Rally of Basse-Normandie, at **Flers,** France.

June 8.—Royal Dutch Aero Club competition for free balloons at **Rotterdam.**

June 8. — Wolverhampton Aero Club members' competition day at **Wolverhampton Airport.**

June 14. — Elstree Flying Club "At Home," at **Elstree Aerodrome,** Herts.

June 14.—Plymouth Aero Club Air Display, at **Roborough Aerodrome,** Plymouth.

June 14-15.—P.F.A. Rally at **Rhoose Airport,** Cardiff.

June 15.—Jodel Air Rally, at **Laon,** France.

June 15-20.—Rally of the Stars, organized by the Milan Aero Club, **Naples-Pescara.**

June 15-29.—World Gliding Championships organized by the Polish Aero Club, at **Leszno,** Poland.

June 16-18.—12th Meeting of AGARD Aeromedical Panel, at the Palais de Chaillôt, **Paris.**

June 18.—Kronfeld Club talk, "The Early Days," by F. N. Slingsby, at 74 Eccleston Square, **London,** S.W.1, at 20.00 hrs.

June 20.—Inst. of Navigation discussion, "The Significance of Blunders in Navigation," at the R.G.S., 1 Kensington Gore, **London,** S.W.7.

June 20-23. — Tour of the Pyrenees, organized by the Lerida Aero Club, **Spain.**

June 20-23.—Ninth International Air Tour of **Sicily** organized by the Palermo Aero Club.

June 21.—Air Display organized by North London Aero Club at **Panshanger Aerodrome,** Herts.

June 22.—R.Ae.S. Garden Party at **White Waltham Aerodrome,** Berks.

June 25-27.—R. Meteorological Society Meeting, at Trinity College, **Dublin.**

June 27-29. — Liège Air Meeting, at **Bierset Aerodrome,** Belgium.

June 28.—Exeter Aero Club, Air Display at **Exeter Airport.**

June 28. — R.A.F.A. Air Display at **Staverton Aerodrome,** Gloucester.

June 28-30.—R.Ae.C. Invitation Air Rally, at **La Baule,** France.

U.K. AGENTS.—Racal Engineering, Ltd., of Bracknell, has become the exclusive agent in the United Kingdom for the sale of Transitron equipment manufactured by Van Norman Industries, Inc., of Manchester, U.S.A. Included in this range are VHF and UHF signal generators.

ELECTRICAL WIRING. — Hellermann, Ltd., of Crawley, Sussex, has introduced a Spirathene conduit for use as a flexible insulated sleeve to allow individual wires to be taken from a cable harness without its removal. It consists of an extruded polythene tube specially manufactured as a wound, close-coiled spiral.

RADAR TUBES.—Two new additions to the M.O. Valve Co.'s range of cathode-ray tubes have been announced by the parent firm, General Electric Co., Ltd. Both airborne radar tubes with long-persistence screens, one is a 5-in. high-definition unit and the other a 9-in. flat-faced tube.

Company Notices

NEW COMPANIES

Aviation Agncies, Ltd. (16,986).—Private co. Reg. in Dublin on April 24. Cap. £5,000 in £1 shs. Objects: To carry on the business of importers, exporters and manufacturers of aircraft and equipment and components for aircraft. Subscribers (each with one sh.): Dermot P. Shaw and James R. Wuirke, solicitors, both of 15 South Frederick St., Dublin. Directors not named.

Carroll and Wright, Ltd. (604,597).—Private co. Reg. May 15. Cap. £500 in £1 shs. Objects: To carry on the business of manufacturers of and dealers in aeronautical instruments, tools, components, fittings and accessories, etc. Directors: Patrick G. Carroll, 68 Melbourne Rd., High Wycombe. John Thomas, "Cartref Hapys," New Rd., Prestwood, Gt. Missenden, Bucks. Sec.: P. G. Carroll. Reg. off.: 14 Temple End, High Wycombe, Bucks.

INCREASE OF CAPITAL

Aircraft Manufacturing Co., Ltd. (598,510). Great Nast Hyde, St. Albans Rd, Hatfield, Herts.—Increased by £999,900 in £1 ordinary shs., beyond reg. cap. of £100.

New Patents

APPLICATIONS ACCEPTED

798,273.—General Motors Corporation.—"Planetary gearing."—Oct. 31, 1956. (Nov. 4, 1955.)

798,286.—General Motors Corporation.—"Support of paired gas turbine engines."—Oct. 22, 1956. (Oct. 24, 1955.)

Applications open to public inspection on July 16, 1958; opposition period expires on Oct. 16, 1958.

Birth Notices

Fleming.—On May 17, at Lympstone, Devon, to Cynthia (*née* Hume), wife of Flt. Lt. P. C. H. Fleming—a son.

Grant.—On May 16, to Ann (*née* Grigg), wife of Sqn. Ldr. F. J. Grant—a daughter.

Hedley.—On May 14, at Cheltenham Maternity Hospital, to Kay, wife of Sqn. Ldr. J. H. Hedley—a daughter.

McVite.—On May 19, at the Louise Margaret Hospital, Aldershot, to Sheila (*née* Gibson), wife of Flt. Lt. A. M. McVite—a son.

Pollock.—On May 22, to Betty, wife of Flg. Off. N. R. Pollock—a son.

Tuke.—On May 19, at Nuffield Maternity Home, Oxford, to Shirley (*née* Pratt), wife of Sqn. Ldr. L. L. Tuke—a daughter.